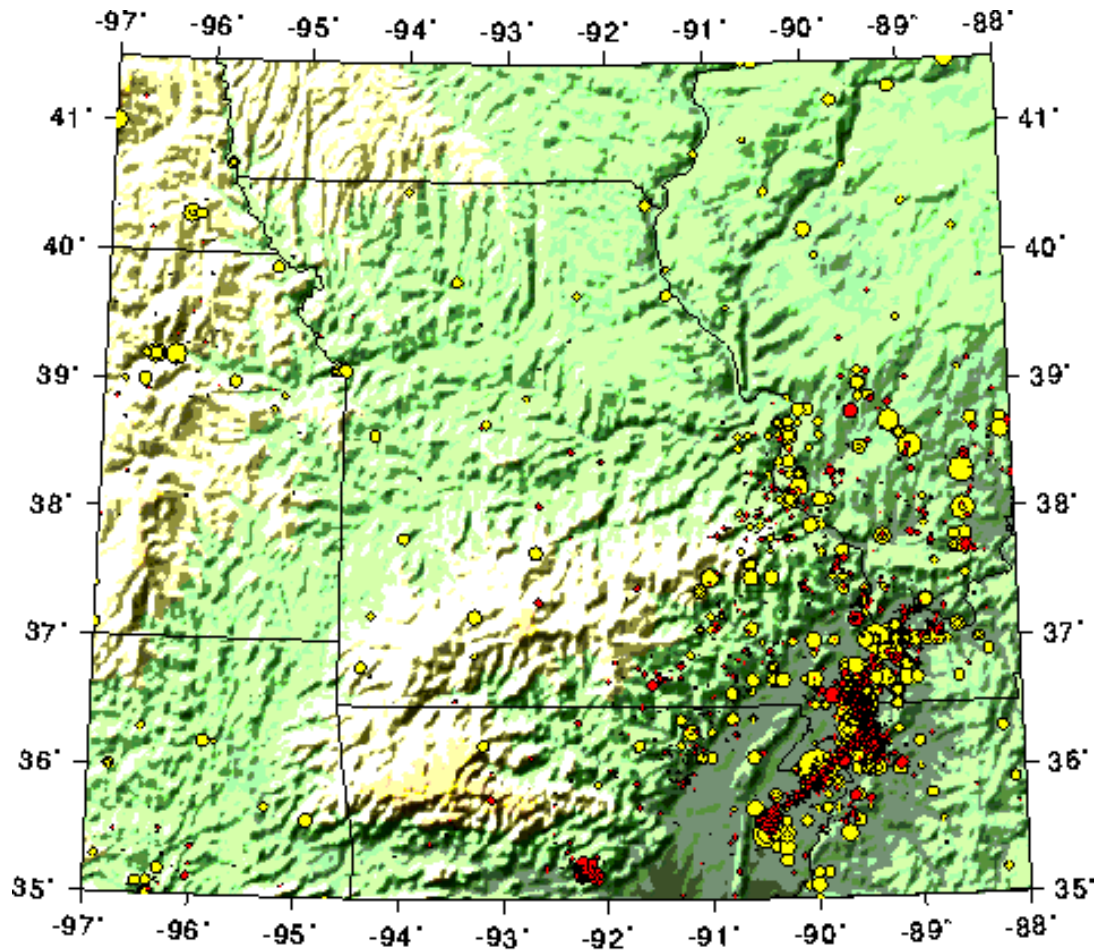


# **A STRATEGIC PLAN FOR EARTHQUAKE SAFETY IN MISSOURI**



**Earthquakes Affecting Missouri**

**Missouri Seismic Safety Commission  
May, 1997**

# Missouri Seismic Safety Commission

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## COVER:

*Map of known earthquakes affecting Missouri. The symbol size is proportional to the earthquake magnitude. Gold colored symbols are events large enough to have been felt since 1811. Red colored symbols are earthquakes instrumentally located since 1974.*

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Additional copies are available from State Emergency Management Agency, P.O. Box 116, Jefferson City, MO 65102

## PREFACE

Past earthquakes have caused great damage in the central United States, including Missouri and other states. The State of Missouri is still vulnerable to earthquake loss. Earthquake damage can be greatly reduced or managed to the benefit of all. This *Strategic Plan for Earthquake Safety in Missouri* develops tangible, practical procedures to prepare Missouri for future earthquakes as well as other natural hazards at the same time. Elements of the plan have been developed to be useful, cost effective and significant for all Missouri citizens and businesses.

This document is the product of a legislative mandate. The State of Missouri enacted Senate Bill No. 142 in 1993, which created the responsibilities of the Missouri Seismic Safety Commission, MSSC. The MSSC and its committees assembled a draft of this plan in October 1996. Considerable planning, interpretation of the enacting legislation, general advice from the State Emergency Management Agency, and participation by state agencies and interested individuals were involved in creating this document. Comments from reviewers were evaluated and incorporated into the plan. Other seismic safety organizations, most notably from the States of California and Utah, have developed documents, planned for earthquakes and conducted relief efforts. A distinct parallel can be found between the MSSC and the Utah Seismic Safety Commission (USSC). The similarity of both Commissions' goals and responsibilities has allowed the MSSC to appraise USSC's reports and to consider common issues. MSSC has incorporated material from federal, state and local programs, documents and activities, as well as its own deliberations, in shaping its strategies. The concepts herein have been assessed and fashioned to the needs of the State of Missouri.

The MSSC, state agencies, local governments, residents and individual businesses may use the plan to begin the large task ahead. This plan will not only aid in projecting goals, but will also evolve as initiatives are taken and new information expands the potential for responding to earthquakes. Priorities have been established but may be revised in the future. The MSSC will attempt to focus these priorities and urge Missouri's stakeholders to pursue these goals within the State's capabilities.

The lessons learned from past U.S. earthquakes have demonstrated the significant burden placed on surviving families, businesses, utilities and state agencies. The great New Madrid earthquakes of 1811-1812, the largest U.S. events in terms of area of major damage, force us to recognize the threat to our region. Preparation now, following the Strategic Plan, will yield significant reductions in fatalities, casualties, damaged structures, business failures, and state infrastructure losses from earthquakes. These same actions will also reduce the impact of other natural hazards.

***The earthquake threat to Missouri cannot be ignored!***

*Last Changed 02/04/97*

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# EXECUTIVE SUMMARY

## Introduction

The mission of the Missouri Seismic Safety Commission is to review Missouri's current preparedness for major earthquakes and to make recommendations to mitigate their impact. By creating this Commission, the State of Missouri has taken an initial, but important step, to prepare for and to reduce the effects of this natural disaster. The recent Northridge, California, and Kobe, Japan, earthquake disasters again show the need for taking active steps to reduce earthquake damage, injuries and deaths in our vulnerable modern society.

The key issues identified by MSSC are as follow:

1. The earthquake threat to Missouri is real. Addressing the problem now will yield significant long-term benefits.
2. The reduction of earthquake risk in Missouri requires the combined efforts of individuals, businesses, industry, professional and volunteer organizations and all levels of government.
3. Most of the strategies identified in this report for reducing earthquake risk can be implemented through proactive, voluntary community participation. Others will require legislation or significant funding.
4. The Missouri Seismic Safety Commission accepts its responsibilities to advance earthquake planning and mitigation in the State as outlined in *A Strategic Plan for Earthquake Safety in Missouri*

## Summary of Objectives

The earthquake problem is multifaceted. This is acknowledged in the legislation establishing this Commission which requires the participation of many different disciplines from basic earth science, engineering, planning and emergency response, to many levels of government. Thus, a plan to address the earthquake problem in Missouri is necessarily detailed.

To organize the Commission's presentation, one can respond to the questions: "What is the threat?", "How do we prepare for the threat?" and "How do we respond to the threat?" These basic questions are organized into five major objectives, within which specific strategies are recommended to address different aspects of the earthquake problem.

### **Objective 1: Increase Earthquake Awareness and Education.**

*Knowledge is a crucial component of the program to minimize risk to our citizens.*

### **Objective 2: Reduce Earthquake Hazard Through Mitigation.**

*Casualties and economic losses can only be avoided by taking positive steps to ensure that structures and systems survive earthquake shaking with minimal damage.*

### **Objective 3: Improve Emergency Response.**

*Response efforts need to be well coordinated, fast and efficient to reduce injury, additional loss of life, and further property destruction.*

### **Objective 4: Improve Recovery.**

*The recovery process helps people resume their normal lives by reducing the emotional and economic impact of the disaster over the long term.*

### **Objective 5: Assess Earthquake Hazard.**

*Readiness for an earthquake requires basic knowledge of expected earthquake locations and the effects of local site conditions on shaking, as well as rapid notification of their occurrence.*

## **Key Priorities for Implementation**

This report contains 37 strategies to meet these five objectives. The strategies, actions and results are presented together at the beginning of each objective of this report, followed by detailed discussion of individual strategies. Recognizing that the strategies have different degrees of urgency, levels of effort, time tables and cost, this Commission has chosen one strategy within each objective for the immediate focus of its efforts. The Commission will endeavor to make significant progress in these areas during the next twelve months. To meet this goal, the Commission requires increased support from and commitment of from the General Assembly.

#### **Objective 1**

*Strategy 1.2 - Increase earthquake awareness among key professionals*

#### **Objective 2**

*Strategy 2.1 - Promote adoption and enforcement of appropriate building codes*

#### **Objective 3**

*Strategy 3.2 - Promote community emergency response teams (CERTs) statewide*

#### **Objective 4**

*Strategy 4.1 - Identify earthquake resistant shelters*

#### **Objective 5**

*Strategy 5.3 - Develop a response team to evaluate post-earthquake effects*

*Last Changed 04/29/97*

## **MISSOURI'S EARTHQUAKE THREAT**

Earthquakes can cause death, injury, major economic loss and social disruption. The 1994 Northridge, California and 1995 Kobe, Japan earthquakes are recent proof.

Missouri has already experienced earthquakes much greater than either the Northridge or Kobe events. During the winter of 1811-1812 three earthquakes estimated to have been magnitude 7.5 or greater were centered in southeast Missouri. Thousands of aftershocks continued for years. While estimates of the recurrence intervals of the large 1811-1812 earthquakes are about 500 - 1000 years, smaller, but still destructive, earthquakes are even more likely. The recurrence interval for a magnitude 6 earthquake is about 100 years. The last such earthquake was in 1895 near Charleston, Missouri.

### **Earthquakes in Missouri**

A sequence of powerful earthquakes struck the mid-Mississippi Valley in the winter of 1811-1812. No fewer than 18 of these events were felt on the Atlantic seaboard, which implies that their magnitudes were greater than 6 - 6.5. The main shocks on December 16, 1811, January 23, 1812 and February 7, 1812 had magnitudes greater than 7.5, making them some of the largest earthquakes known in the continental United States. Since then, large earthquakes have continued to occur: significant earthquakes, each about magnitude 6, occurred in 1843 near Marked Tree, Arkansas, and on October 31, 1895 near Charleston, Missouri. Earthquakes affecting the region are not restricted to the Bootheel. The magnitude 5.5 earthquake, November 9, 1968 in southeastern Illinois caused minor damage in St. Louis. Other earthquakes have occurred throughout southeastern parts of Missouri. The figure on the cover of this report shows the distribution of historic known earthquakes in the region.

Active research projects on the nature of the earthquake problem are being sponsored through the National Earthquake Hazards Reduction Program (NEHRP). These investigations have documented large earthquakes prior to 1811-1812, thus reinforcing concern for the future. Other efforts generated updated probabilistic hazard maps that show the degree of the earthquake threat in southeastern Missouri.

### **Earthquake Hazards**

The most important direct earthquake hazard is ground shaking. Ground shaking affects structures close to the earthquake epicenter but can also affect those at great distances. Certain types of buildings may be damaged by earthquakes at a significant distance from the epicenter. This places most of southeastern Missouri, as well as the St. Louis metropolitan area, at risk. Unreinforced masonry structures, tall structures without adequate lateral resistance, and poorly-maintained structures are specifically susceptible to large earthquakes. Owners of these structures should be aware of their potential for seismic damage.

Indirect hazards may also occur at great distances from large earthquakes. Liquefaction, landslides and life-line disruptions will most affect areas closest to the epicenter, but may occur at significant distances. The impact on the general public, small- to medium-size businesses, life-line services, and the infrastructure may be radically lessened if precautions are undertaken at multiple levels.

The flat-lying, southeastern (Bootheel) section of Missouri is most susceptible to earthquakes because it overlies the New Madrid fault zone. It is the epicentral area of the 1811-1812 earthquakes and seismic activity continues there. It also has the highest risk because its subsurface conditions -- loose sediments and a high water table -- tend to amplify earthquake ground shaking. The immediate vicinity of the Ozarks is also at risk from is also at risk from earthquakes in the New Madrid fault zone. Like the Bootheel, subsurface conditions of the Mississippi and Missouri River valleys tend to amplify earthquake ground shaking. As a result, these areas, including much of metropolitan St. Louis, are also at high risk from earthquakes. Earthquake hazards in the western part of the state also exist because of the historical earthquakes in eastern Kansas and Nebraska. No area of Missouri is immune from the danger of earthquakes. Minor, but potentially damaging, earthquakes can occur anywhere in the state.

Increased education, concern and subsequent action can reduce the potential effects of earthquakes, and this can be done in conjunction with preparations for other natural hazards. A program that recognizes the risk of flooding, landslides and other dangers and which incorporates earthquake issues, will be the most beneficial to our citizens.

Individuals and all levels of government have roles in reducing earthquake hazards. Individuals can reduce their own vulnerability by taking some simple and inexpensive actions within their own households. Local government can take action to lower the threat, through the proper use of poor sites, assuring that vital or important structures (police, fire and school buildings) resist hazards, and developing infrastructure in a way that decreases risk. State agencies and the legislature can assist the other levels of action and provide incentives for minimizing hazards.

*Last Changed 04/29/97*



## **Objective 1: Increase Earthquake Awareness and Education.**

*Knowledge is a crucial component of the program to minimize risk to our citizens.*

| <b>Strategy</b>   | <b>Action</b>   | <b>Result</b>   |
|---|---|---|
| 1.1 Increase awareness of earthquakes and earthquake risk in Missouri among the general public.                   | Deliver information about earthquakes and earthquake risk in Missouri to the general public.  | The general public becomes better equipped to prepare for, survive and recover from future earthquakes in Missouri.   |
| 1.2 Increase awareness of earthquakes and earthquake risk in Missouri among key professionals in critical fields. | Encourage, endorse, support, and help develop earthquake awareness professional development programs, and enlist the help of key professionals in leading the overall awareness and education effort. | Key professionals in critical fields will learn how to mitigate earthquake damage and the awareness and education effort will gain momentum and resources.  |
| 1.3 Increase awareness of earthquakes and earthquake risk in Missouri among K-12 students.                        | Teach all Missouri K-12 students about earthquakes and earthquake risk, from both an earth science and a public safety perspective.   | Future generations of Missourians will be better equipped to prepare for, survive, and recover from future earthquakes. This will prepare them for their futures, whether they remain in Missouri, move to California, vacation in Alaska or Hawaii, or do business in Japan. |

*Last Changed 02/04/97*

## **STRATEGY:**

Increase awareness of earthquakes and earthquake risk in Missouri among the general public.

## **ACTION:**

Deliver information about earthquakes and earthquake risk in Missouri to the general public.

## **RESULT:**

The general public becomes better equipped to prepare for, survive and recover from future earthquakes in Missouri.

---

## **Background**

Much information is now available on earthquakes and earthquake risk in Missouri. Most of it is printed material generated by the Federal Emergency Management Agency (FEMA); the State Emergency Management Agency (SEMA); the Center for Earthquake Studies (CES); the U.S. Geological Survey (USGS); the Division of Geology and Land Survey (DGLS); the American Red Cross; and other State, Federal, and private sources. This printed information has been available to the general public for years.

Other ways of increasing awareness of earthquakes and earthquake risk to the general public have also been used in the past. Means such as Earthquake Awareness Week, permanent and mobile exhibits, public speakers, earthquake drills, and others have been tried in the past, with varying degrees of success.

## **Implementation**

Results could be improved by using different and more appealing ways, offered actively and often, to get the attention of the general public. An "earthquake awareness cheerleader" needs to be designated and funded adequately to function as such. Broadcast and print media can be contacted regularly. Rapport with media professionals should be established and maintained. Earthquake awareness needs to be marketed to the general public; it needs to shift gears from a passive to an active approach. A few ideas follow.

Encourage permanent displays in museums throughout the state on earthquakes in general, past earthquakes in Missouri, earthquake risk in Missouri, real-time seismographs, earthquake safety, earthquake preparedness, and current earthquake research topics.

Offer technically qualified and entertaining public speakers to speakers' bureaus and radio industry resources [databases from which speakers on talk-radio are found] throughout the state.

Develop and maintain an Internet Home Page on earthquakes and earthquake risk in Missouri. Update the home page as needed, at least monthly. Include a calendar of earthquake-related professional development training, short courses, continuing education, and workshops.

Develop and/or endorse "envelope stuffers" for utilities to include in their billing envelopes. "Envelope stuffers" outline earthquake safety, risk factors and earthquake history in Missouri. The Public Service Commission (PSC) could help in developing and distributing these envelopes.

Solicit support from key public and private organizations. Utilities, corporations, local service organizations, professional organizations, government agencies, and others can help to develop a network for information dissemination.

Create public service announcements which outline earthquake safety, risk factors and earthquake history in Missouri for the broadcast media.

Develop mobile displays for shopping malls, fairs, libraries, public buildings, special events, and airports that outline earth-quake safety, risk factors and earthquake history in Missouri.

Encourage public and commercial television stations to broadcast earthquake-related programs, such as "Hidden Fury: The New Madrid Fault Zone" and others as available.

Sponsor annual Earthquake Awareness Week (the week in which February 7 falls each year). Target envelope stuffers, public service announcements, public speeches, radio interviews, mobile displays, school earthquake drills, and poster contests to peak in this week. The overall message should state that this is the week to review, reevaluate, and rotate emergency supplies, such as changing batteries, rotating stored water and food supplies, adding diapers if there is a new baby in the household, and including new medications.

Issue regular and special press releases to appropriate news media points of contacts. Topics could include each full meeting of the Missouri Seismic Safety Commission, approaching anniversaries of significant historical earthquakes, announcements of significant technical discoveries or insights into earthquakes and earthquake risk in Missouri and planned earthquake drills.

Have press releases prepared in advantage to take advantage of a "window of opportunity," such as a larger high-visibility earthquake worldwide, a moderate earthquake in the midwest or another natural disaster in Missouri.

### **Responsible Agencies:**

Department of Public Safety  
State Emergency Management Agency  
Center for Earthquake Studies  
Department of Natural Resources, Division of Geology & Land Survey  
American Red Cross  
U. S. Geological Survey (USGS)  
Federal Emergency Management Agency (FEMA)

*Last Changed April 28, 1997*

## **STRATEGY:**

Increase awareness of earthquakes and earthquake risk in Missouri among key professionals in critical fields.

## **ACTION:**

Encourage, endorse, support, and help develop earthquake awareness professional development programs, and enlist the help of key professionals in leading the overall awareness and education effort.

## **RESULT:**

Key professionals in critical fields will learn how to mitigate earthquake damage and the awareness and education effort will gain momentum and resources.

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## **Background**

Courses and workshops developed by FEMA have been presented to engineers, hospital administrators, architects, and others periodically. Most of these have been in the area of structures and design.

## **Implementation:**

There are many ways to approach key professionals in critical fields. A general list follows.

Sponsor, support, and encourage professional development of engineers, architects, and other design professionals through short courses, continuing education, and workshops. Enlist help of professional organizations and others.

Sponsor, support and encourage professional development of builders, general contractors, and other construction professionals through short courses, continuing education, and workshops. Enlist cooperation of trade unions, public and private trade and technical schools, University of Missouri Extension, and others.

Sponsor, support and encourage professional development of owners and operators of large facilities and buildings through short courses, continuing education, and workshops. Enlist cooperation of metro and state-wide safety councils, Building Owners & Managers Association (BOMA), St. Louis Construction Consumers Council, University Extension, and others.

Sponsor, support, and encourage professional development of owners, operators, and key users of large engineered systems (i.e., executive and strategic managers and directors) through short courses, continuing education, and workshops. Participants include personnel with utilities, transit districts, railroads, airports, pipelines, mines, river

transporters, dam owners, hazardous waste handlers, underground space, etc. Enlist cooperation of professional associations and other organizations.

Sponsor, support and encourage professional development of owners, operators, and key users of electronic systems (i.e., executive and strategic management and directors) through short courses, continuing education, and workshops. Participants include data managers and processors, and those in telecommunications networks, banks and financial institutions, Internet service providers, broadcast stations, etc. Enlist cooperation of professional associations and other organizations.

Sponsor, support and encourage professional development of media professionals through short courses, continuing education, and workshops. Participants include reporters, news and assignment editors, and others at newspapers and television and radio stations. Enlist cooperation of professional associations and other organizations.

Sponsor, support and encourage professional development of government officials through short courses, continuing education, and workshops. Participants include city, county, and state elected and appointed officials; school board members; industrial developers; planning and zoning officials; public-body risk managers; emergency preparedness officers; etc. Enlist cooperation of Missouri Association of Counties (MAC), Missouri Intergovernmental Risk Management Association (MIRMA), Missouri Municipal League (MML), and others.

Points of Contact:

Department of Elementary and Secondary Education, State Board of Education,  
Division of Vocational and Adult Education  
Department of Elementary and Secondary Education, Missouri Advisory Council  
on Vocational Education  
Department of Economic Development, Division of Job Development and Training  
Department of Economic Development, Division of Professional Registration  
Department of Economic Development, Missouri Board for Architects,  
Professional Engineers, and Land Surveyors  
Department of Economic Development, Missouri Board of Geologist Registration  
Department of Economic Development, Office of Health Care Providers  
Department of Economic Development, Real Estate Appraisers' Commission  
Department of Economic Development, Missouri Real Estate Commission  
University of Missouri Extension  
American Society of Civil Engineers (ASCE)  
American Institute of Architects (AIA)  
American Institute of Professional Geologists  
American Public Works Association (APWA)  
Association of Engineering Geologists  
Associated General Contractors  
Associated Industries of Missouri  
Association of Missouri Electric Cooperatives  
Building Owners & Managers Association (BOMA)  
Earthquake Engineering Research Institute (New Madrid Chapter)  
Consulting Engineers of Missouri (CECMo)  
Missouri Alliance for Historic Preservation  
Missouri Apartment Association  
Missouri Association for Community Action  
Missouri Association of Councils of Government

Missouri Association of Counties  
Missouri Association of Homes for the Aging  
Missouri Association of Private Career Schools  
Missouri Bankers Association  
Missouri Broadcasters Association  
Missouri Chapter of American College & Emergency Physicians  
Missouri Child Care Association  
Missouri Community College Association  
Missouri Cooperative Extension Service  
Missouri Emergency Medical Services Association  
Missouri Hospital Association  
Missouri Hotel & Motel Association  
Missouri LP Gas Association  
Missouri League of Nursing Home Administrators  
Missouri Municipal League  
Missouri Safety Council  
Missouri Society of Professional Engineers  
Missouri State Council of Carpenters  
Missouri Vocational Association  
St. Louis Construction Consumers Council  
SAVE Coalition

**Responsible Agencies:**

State Emergency Management Agency

*Last Changed April 28, 1997*

**STRATEGY:**

Increase awareness of earthquakes and earthquake risk in Missouri among K-12 students.

**ACTION:**

Teach all Missouri K-12 students about earthquakes and earthquake risk, from both an earth science and a public safety perspective.

**RESULT:**

Future generations of Missourians will be better equipped to prepare for, survive, and recover from future earthquakes. This will prepare them for their futures, whether they remain in Missouri, move to California, vacation in Alaska or Hawaii, or do business in Japan.

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**Background**

Kindergarten through 12th-grade students may be the most receptive to learning about earthquakes and earthquake risk. Many earthquake/ earthquake risk resources are available, both in hardcopy and in electronic form via the Internet. Excellent materials are available from FEMA and others sources.

**Implementation**

Some ways to increase awareness of earthquakes and earthquake risk among K-12 students follow.

Sponsor, support and encourage use of study units on earthquakes, earthquake risk, earthquake safety, and related topics. Use modules already available from FEMA and other sources. Incorporate study of earth science, natural and human history, math, geography, physics, computer science, individual research, and other subjects in an age-appropriate manner.

Sponsor, support and encourage enthusiastic earthquake drills and safety exercises in each public and private K-12 school in Missouri.

Sponsor, support and encourage earthquake safety poster contests in grades K-6. Displays of local entries will be posted in schools, libraries, public buildings, etc. Local winners will compete statewide; final winners will be used in televised public service announcements for following years' Earthquake Awareness Week.

**Responsible Agencies:**

Department of Elementary and Secondary Education, Division of Instruction  
Missouri Association of Teaching Christian Homes, Inc.  
Families for Home Education, Inc.  
Association of Missouri private schools

*Last Changed April 28, 1997*



## Objective 2: Reduce Earthquake Hazard Through Mitigation.

*Casualties and economic losses can only be avoided by taking positive steps to ensure that structures and systems survive earthquake shaking with minimal damage.*

| Strategy   | Action  | Result   |
|--|---|--|
| 2.1 Promote the adoption and enforcement of technically sound and economically feasible codes, standards and procedures for the design and construction of new structures and additions to existing structures.  | Design buildings to resist earthquakes and encourage local government to adopt a building code for seismic design as required by Chapter 319 of the Revised Statutes of Missouri. Seismic design should be a part of the engineering and architecture curricula at state universities and colleges and included in the testing required for licensing engineers. Promote continuing education for architects and engineers. | Overall damage to structures from future earthquakes will be reduced if the codes, standards and procedures are adopted and implemented. |
| 2.2 Identify existing structures especially susceptible to earthquake damage and develop methods to reduce such damage.  | Develop a plan for increasing the seismic resistance of essential facilities in a cost-effective and politically feasible manner. Encourage universities and professional societies to provide educational opportunities to design professionals in the methodology of seismic rehabilitation of structures.  | Seismic retrofitting of existing structures will reduce the damage caused by earthquakes.  |
| 2.3 Establish a process reviewing construction documents and inspecting construction of buildings and structures for compliance with the seismic provisions of the <i>NEHRP Recommended Provisions for the Development of Seismic Regulations for New Buildings</i> or the building codes adopted by the appropriate jurisdiction. | Identify qualified resources for the review of construction documents and appropriate inspection of construction.   | Protection of the public from injury and loss of life caused by structural failure.  |

|   |   |   |
|---|---|---|
| 2.4 Mitigate non-structural hazards for hospitals, schools and other critical facilities                                    | Strengthen non-structural building components to resist earthquake damage and provide backup utility service to support post-earthquake functions in hospitals and other critical facilities.   | Hospitals, schools, and other critical facilities would be available for immediate occupancy after a major earthquake if the site utilities are operable and structural damage is negligible.                 |
| 2.5 Review Missouri dam safety criteria relative to potential earthquake hazards.   | Evaluate present rules and, if needed, recommend appropriate design and construction rules. Use these rules to assess the seismic safety of new dams.   | New dams in Missouri will be more resistant to earthquake shaking   |
| 2.6 Accelerate the program to assess, retrofit and/or replace bridges that do not meet current earthquake design standards. | Assess, retrofit, and/or replace bridges in a more timely manner.   | Reduced risk of collapse or severe damage to highway bridges. Bridges which are at risk of failure or damage will be retrofitted or replaced in a timely manner, which will facilitate response and recovery. |
| 2.7 Minimize the risk for hazardous material spills and contamination that may be caused by an earthquake.                  | Assess potential for hazardous material spills resulting from earthquakes and implement ways to minimize that risk.   | Reduced risk to property and the environment resulting from hazardous material spills, caused by an earthquake.   |
| 2.8 Conduct critical lifeline co-location vulnerability studies.  | Identify lifeline co-location sites in earthquake-prone areas where the hazard of ground failure is high and where vulnerable structures support co-located lifelines; develop a mitigation plan for each one. Encourage equipment improvement, facility redundancy and relocation, and pre-event response and recovery agreements. | During an earthquake emergency, damage to one lifeline will not cripple an adjacent lifeline, when the recognized hazard is anticipated and accommodated.   |
| 2.9 Promote local government assessment of sites for new critical facility and school.                                      | Encourage local governments to adopt land-use planning and ordinances to locate critical facility and school sites in areas less vulnerable to natural hazards.   | Loss of life will be reduced and the operational status of critical facilities will be maintained by considering land-use and building factors relative to earthquakes and other natural hazards.             |

|  |   |   |
|--|---|---|
| <p>2.10 Support educational, regulatory, legislative and market-based efforts to promote insurer ability to respond to seismic catastrophes.</p> | <p>Support educational efforts to aid the public in understanding their role in mitigating damage, the nature of catastrophe insurance, the role of deductibles, and threats to solvency. Support educational, regulatory and legislative efforts aiding the availability and affordability of insurance.</p> | <p>There will be a financially sound catastrophic insurance business, wide public acceptance of need to carry earthquake insurance with substantial deductibles, and public support of commercial and residential earthquake-resistant building design. Adequate measures will be in place to assure that construction can withstand expected stresses in reasonably safe ways.</p> |
|--|---|---|

*Last Changed 01/30/97*

## **STRATEGY:**

Promote the adoption and enforcement of technically sound and economically feasible codes, standards and procedures for the design and construction of new structures and additions to existing structures.

## **ACTION:**

Design buildings to resist earthquake and encourage local government to adopt a building code for seismic design as required by Chapter 319 of the Revised Statutes of Missouri. Seismic design should be a part of the engineering and architecture curricula at state universities and colleges and included in the testing required for licensing engineers. Promote continuing education for architects and engineers.

## **RESULT:**

Overall damage to structures from future earthquakes will be reduced if the codes, standards and procedures are adopted and implemented.

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## **Background**

Life safety protection of the public can be improved by statutes requiring seismic design, by policies adopted by government agencies and private industry, or, in the case of buildings, by the adoption of model building codes. The cost of designing and constructing new structures to conform with current codes is usually small, i.e., 1 to 5 percent of the construction cost.

### **Legislation**

Chapter 319 to 319.200, Earthquakes - Seismic Building and Construction Ordinances, of the Revised Statutes of Missouri contains seismic design requirements. Beginning January 1, 1991 each city, town, village or county in Missouri which can be expected to experience an intensity of ground shaking equivalent to a Modified Mercalli Intensity of VII or greater from an earthquake along the New Madrid Fault with a potential magnitude of 7.6 on the Richter Scale shall adopt an ordinance or order requiring that new construction and additions to existing buildings and structures comply with the standards for seismic design and construction of the UBC or BOCA Codes. Seismic design criteria for additions apply only to structural components constituting the alteration and shall not be applied to require reconstruction or fortification of existing structures proposed to be altered.

Most small municipalities and rural counties do not have the resources to properly review plans and specifications to assure compliance with a building code. Consideration could be given to having the Division of Design and Construction in Jefferson City assume this responsibility for jurisdictions that do not have the resources.

## **Implementation**

Revise Section 319.200 of the Missouri Statutes "Earthquakes - Seismic Building and Construction Ordinances," to require buildings in the State of Missouri to be designed in accordance with building codes based upon the latest version of the National Earthquake Hazards Reduction Program (NEHRP) provisions for the design of new buildings.

Require local governments to comply with these seismic design provisions. Identify resources to assure that the code provisions are enforced.

The City of St. Louis and St. Louis county have adopted a 25-50 rule pertaining to upgrading of existing buildings to meet seismic design requirements. The rule is as follows:

If the cost of renovation exceeds 50 percent of the assessed valuation of the property, the building must meet all requirements of the building code, including seismic. If the cost of the renovation work is between 25 and 50 percent, the buildings commissioner shall make a determination as to what extent the buildings must meet the current code. If the cost of renovation is less than 25 percent of the assessed value, then no upgrading of the facility is required.

Local governments besides the City of St. Louis and St. Louis County should be encouraged to adopt this approach to reducing seismic risk.

Encourage all engineering and architectural schools in Missouri to include seismic design in their curricula and the respective registration boards to include seismic design on licensing exams. Encourage professional societies to provide appropriate continuing education courses on earthquake resistant design.

## **Responsible Agencies:**

Local government  
Registration Board  
State Fire Marshal

*Last Changed April 28, 1997*

## **STRATEGY:**

Identify existing structures especially susceptible to earthquake damage and develop methods to reduce such damage.

## **ACTION:**

Develop a plan for increasing the seismic resistance of essential facilities in a cost-effective and politically feasible manner. Encourage universities and professional societies to provide educational opportunities to design professionals in the methodology of seismic rehabilitation of structures.

## **RESULT:**

Seismic retrofitting of existing structures will reduce the damaged caused by earthquakes.

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## **Background**

The comparative costs of retrofitting existing structures in order to make them more earthquake resistant are generally greater than for new construction. In many cases this may not be economically feasible. While it may not be politically feasible to mandate

retrofitting of all susceptible buildings, e.g., unreinforced masonry apartments, building owners should be encouraged to do so when possible. This is especially important for critical facilities such as hospitals and emergency response facilities.

The magnitude of this task is illustrated by inventories in the St. Louis area. A tabulation of structures in the area critical to post-earthquake recovery included 15 at airports, 42 at ambulance stations, 160 at fire stations, 33 at hospitals and 97 at police stations. Within the City of St. Louis, there were about 98,000 residential structures of which 62,000 are single-family, 20,000 were two-family and 16,000 were three or more family. Of these structures 75 percent are unreinforced masonry and 25 percent are frame construction.

Similar inventories are not available for the rest of the area of concern, but it has been suggested that an estimate of the total number of structures in a region may be obtained by multiplying the population by a factor of 0.35 or 0.40.

## **Implementation**

Development of a strategy for retrofitting existing structures warrants careful study. For example, mandating retrofitting of unreinforced masonry residential structures could result in the abandonment of many such structures because economics might not justify the expenditure. This could create hardships for low-income residents and contribute to the blighting of neighborhoods. On the other hand, incentives such as tax and insurance reductions, may be attractive inducements. The appropriate organization to develop a plan to develop an effective strategy should be identified.

The first priority should be given to retrofitting critical facilities that will be essential for post-earthquake recovery. Hospitals, fire stations, police stations and other critical facilities should be encouraged to assess the vulnerability of their structures and develop a plan for retrofitting them. FEMA 273 contains provisions for retrofitting existing structures. An inventory of critical buildings should be undertaken in eastern Missouri, especially in southeastern Missouri. The condition of these structures should be initially assessed using the Rapid Visual Screening of Buildings for potential seismic hazards (ATC-21). Assessment of the vulnerability of critical buildings should also take into account the soil conditions.

Elementary and secondary schools, colleges and universities should be encouraged to assess their vulnerability and to retrofit seriously deficient structures. Architects, engineers and building officials should be trained in the methods for cost-effective seismic upgrades of existing buildings.

Each critical facility should be required to submit a "report of vulnerability" to its governing authority. This report would assess the most vulnerable elements of their structures, i.e., those which when damaged would render their facilities unusable or unable to carry out their essential functions. With this information, a prioritized plan can be developed with cost estimates and a schedule for upgrading. The seismic upgrading requirements for critical facilities should be used by building owners in their capital improvement plans. Tax and insurance incentives should also be considered to encourage retrofitting of essential facilities.

**Responsible Agencies:**

Missouri Division of Geology and Land Survey  
Missouri Department of Insurance  
Department of Health  
Department of Education  
Department of Higher Education  
Local government  
Registration board

*Last Changed April 28, 1997*

## **STRATEGY:**

Establish a process reviewing construction documents and inspecting construction of buildings and structures for compliance with the seismic provisions of the NEHRP Recommended Provisions for the Development of Seismic Regulations for New Buildings or the building codes adopted by the appropriate jurisdiction.

## **ACTION:**

Identify qualified resources for the review of construction documents and appropriate inspection of construction.

## **RESULT:**

Protection of the public from injury and loss of life caused by structural failure.

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## **Background**

The seismic requirements of a Building Code are complex and, consequently, not fully understood by all members of the design profession. Furthermore, many governmental entities responsible for the enforcement of seismic requirements lack the resources and/or the dedication to review the contract documents for compliance or to provide adequate inspection of construction. The result is that the public is not being protected as required by law.

## **Implementation**

Develop local expertise for review of construction documents and construction inspection or contract with a qualified government agency or independent professional group for the review.

## **Responsible Agencies:**

Division of Design and Construction  
State Fire Marshal  
County government

*Last Changed April 28, 1997*



## **STRATEGY:**

Mitigate non-structural hazards for hospitals, schools and other critical facilities.

## **ACTION:**

Strengthen non-structural building components to resist earthquake damage and provide backup utility service to support post-earthquake functions in hospitals and other critical facilities.

## **RESULT:**

Hospitals, schools, and other critical facilities will be available for immediate occupancy after a major earthquake if the site utilities are operable and structural damage is negligible.

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## **Background**

All buildings can be considered to be composed of two components, namely structural and non-structural parts. The structural parts, columns and beams, support the building. The non-structural parts, e.g., enclosure walls and windows, and electrical and mechanical systems, are the focus of this Strategy. In an earthquake, if the structure survives, that is, it has not collapsed and is safe, the building may not be suitable for occupation because of a lack of enclosure, heat, cooling, electrical, or water service. Even if a building is structurally safe, it may not be usable.

Since the majority of all hospitals, schools, police and fire facilities, jails and court houses were built prior to any seismic code requirements, there is a high likelihood that the normal functions of the building would cease due to a lack of windows, heat or power should a structure withstand even moderate earthquake shaking. Those buildings, and the people who occupy them, will be in need more than ever after an earthquake. The critical services of medical, security, and fire personnel will be largely unavailable if the power, phone, gas, water, or sewer service within the structure is not working. If a wall collapses into a street, how can a fire apparatus be used on a fire caused by a severed gas line?

Mitigation of non-structural hazards in critical buildings is the first line of defense in keeping civil services available they are most needed. This can also be the most cost-effective prevention strategy. Retrofit mitigation techniques have proved their worth time after time.

## **Implementation**

Require that each facility owner submit a "Report of Vulnerability" to its governing authority. This report would identify those non-structural building components and systems that, when damaged, would render the facility unusable or unavailable for its normal functions. With this information, a prioritized plan could be developed along with a budget for execution on a set schedule. The governing authorities for these facilities could then monitor the progress of implementation and assess appropriate awards or sanctions, i.e. certification, funding, etc.

## **Responsible Agencies:**

State departments of education  
State Fire Marshal  
State Attorney General  
Joint Commission of Hospital Certification  
Public Service Commission  
Division of Design and Construction  
Department of Corrections  
Missouri Supreme Court

*Last Changed April 28, 1997*

**STRATEGY:**

Review Missouri dam safety criteria relative to potential earthquake hazards.

**ACTION:**

Evaluate present rules and, if needed, recommend appropriate design and construction rules. Use these rules to assess the seismic safety of new dams.

**RESULT:**

New dams in Missouri will be more resistant to earthquake shaking

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**Background**

The State of Missouri has developed a sound program for dam safety including existing dams, construction of new dams, and maintenance of dams. Potential earthquake shaking effects are applied to the construction of new dams and to other dams if there appear to be demonstrable safety hazards as outlined by State statutes.

The regulations relative to seismicity are based on a 1980 understanding of potential seismic effects. While there have not been major changes in the knowledge concerning the types of dams regulated by the State of Missouri since that period, there are new concepts that should be reviewed. For example, the 1980 probabilistic analysis that addressed seismic loading may not be current, given the existence of several new studies, such as risk-based ground motion mapping by the U.S. Geological Survey. Also, earthquake-induced deformations rather than accelerations could be more appropriately used relative to dam design in designated areas. Also, changes may be needed relative to the downstream environment as it pertains to public safety.

**Implementation**

The review should be accomplished by a panel of specialists. This panel should include persons who are very familiar with the Missouri Statute that addresses dam safety and the spirit of that statute, such as a representative of the Dam and Reservoir Safety Council and a program staff member. Other panelists should be included: a seismologist having knowledge of earthquake activities and potential effects in the Midwest; and a geotechnical engineer with a background in the seismic effects on dam foundations. Seismic provisions of the rules will apply to new dams.

**Responsible Agencies:**

Division of Geology and Land Survey, Department of Natural Resources  
(DGLS/DNR)  
State Emergency Management Agency, Department of Public Safety

*Last Changed April 28, 1997*

**STRATEGY:**

Accelerate the program to assess, retrofit and/or replace bridges that do not meet current earthquake design standards.

**ACTION:**

Assess, retrofit, and/or replace bridges in a more timely manner.

**RESULT:**

Reduced risk of collapse or severe damage to highway bridges. Bridges that are at risk of failure or damage will be retrofitted or replaced in a timely manner, which will facilitate response and recovery.

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**Background**

The Missouri Department of Transportation (MoDOT) performed an initial assessment of bridge earthquake vulnerability in Missouri in 1990. The task force identified priority routes in the high risk areas in the southeastern part of the state. Approximately 633 bridges were identified with an estimated cost of \$70 million for retrofitting. The Task Force recommended that a 10-year program be established to retrofit these bridges and that the legislature fund this work separately from the normal highway program. Some retrofit projects have been undertaken, but the number of bridges handled so far (in 1996) is small.

**Implementation**

The legislature needs to authorize a long-term (10-year) program for retrofitting high risk bridges and provide the necessary funding. This program should include a bridge ranking system that prioritizes the structures so that the more critical bridges are retrofitted first.

MoDOT should request funds from the re-authorization of the Intermodal Surface Transportation Efficiency Act (ISTEA) that were specifically allocated for retrofitting bridges.

**Responsible Agencies:**

Missouri Department of Transportation (MoDOT)

*Last Changed April 28, 1997*

## **STRATEGY:**

Minimize the risk for hazardous material spills and contamination that may be caused by an earthquake.

## **ACTION:**

Assess potential for hazardous material spills resulting from earthquakes and implement ways to minimize that risk.

## **RESULT:**

Reduced risk to property and the environment resulting from hazardous material spills, caused by an earthquake.

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## **Background**

Hazardous materials are routinely shipped throughout Missouri by train, truck, pipeline and barge. Serious environmental threats have been generated by transportation accidents involving hazardous materials. Many companies located in eastern Missouri store and manufacture hazardous materials. These facilities should be designed and/or retrofitted to make them more earthquake resistant. Hazardous materials can also be a deterrent to post-earthquake inspection of buildings because of the risk of exposure to volunteers inspecting buildings after an earthquake.

40 CFR 112 requires facilities storing or using petroleum in regulated quantities from above-ground tanks to implement a Spill Prevention Control and Countermeasure Plan to control the release of such materials.

The Oil Pollution Act of 1990 requires facilities posing a substantial threat of releasing oil to a waterway to have a contingency plan for responding to releases.

The Emergency Planning and Community Right-to-Know Act requires facilities storing or using regulated quantities of hazardous materials to report those materials and their maximum quantities to both local and State authorities.

Section 112 of the Clean Air Act requires facilities storing or using regulated hazardous materials in certain quantities to develop Risk Management Plans including Emergency Response Plans and to provide that information to State and local governments.

The implementation and enforcement of these programs will greatly aid in meeting the objectives of this strategy. However, the level of funding may not be adequate to meet the objectives within an appropriate time frame.

## **Implementation**

The Missouri Hazardous Waste Law (10 CSR 23-6) requires that an applicant for a hazardous waste management facility permit to design and construct the facility to withstand stresses from earthquake loading or certify that the existing facility is able to withstand stresses from an earthquake. Existing facilities may use the seismic standard specified in the UBC or BOCA codes as a basis for certification. The certification must be completed by a qualified independent professional engineer registered in Missouri.

The Missouri Department of Natural Resources (DNR) should assess whether the risks of hazardous materials spills are adequately managed in Missouri. DNR should also ascertain if hazardous waste management facilities are designed and operated in a manner that minimizes earthquake risks. Procedures should be in place to minimize the risks of exposure to hazardous materials by emergency response personnel, including volunteer inspectors who respond to an earthquake.

DNR should verify all SPCC Plans and other laws regulating the manufacture, transport, storage, use and disposal of hazardous materials. This may require an increase in funding for the agency to fulfill its responsibility for earthquake hazards.

### **Responsible Agencies:**

Missouri Department of Natural Resources (DNR), Division of Environmental  
Quality  
Missouri Department of Natural Resources (DNR), Division of Energy  
Missouri Department of Natural Resources (DNR), Division of Geology and Land  
Survey  
State Fire Marshal  
Public Service Commission

*Last Changed April 28, 1997*

## **STRATEGY:**

Conduct critical lifeline co-location vulnerability studies.

## **ACTION:**

Identify lifeline co-location sites in earthquake-prone areas where the hazard of ground failure is high and where vulnerable structures support co-located lifelines; develop a mitigation plan for each one. Encourage equipment improvement, facility redundancy and relocation, and pre-event response and recovery agreements.

## **RESULT:**

During an earthquake emergency, damage to one lifeline will not cripple an adjacent lifeline, when the recognized hazard is anticipated and accommodated.

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## **Background**

In many locations, various lifelines, including pipelines, rail, highway, electric, and communications, are located within close proximity of each other, either in defined corridors or at crossings. Seismic damage to one lifeline may easily impact adjacent lifelines. An example would be an interstate pipeline crossing. The failure of a single lifeline may be repaired within a reasonable time, but the failure of two (or more) adjoining lifelines could pose complex repair problems. Significant delays may result from the complexity of repairs, slowing the operational return of vital public services essential to public health and safety.

## **Implementation**

Undertake studies to identify all critical co-location sites within earthquake-prone areas. Establish a task force of public and private lifeline operators to estimate the potential impacts from damage to adjacent lifelines on their systems.

## **Responsible Agencies:**

State Emergency Management Agency, Department of Public Safety (SEMA-DPS)  
Missouri Department of Transportation (MoDOT)  
Division of Geology and Land Survey, Department of Natural Resources (DGLS-DNR)  
Public Service Commission  
Municipal and private utilities, railroads, and pipeline operators

*Last Changed April 28, 1997*

## **STRATEGY:**

Promote local government assessment of sites for new critical facilities and schools.

## **ACTION:**

Encourage local governments to adopt land-use planning and ordinances to locate critical facilities and school sites in areas less vulnerable to natural hazards.

## **RESULT:**

Loss of life will be reduced and the operational status of critical facilities will be maintained by considering land-use and building factors relative to earthquakes and other natural hazards.

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## **Background**

State and local government agencies should consider all natural hazards when siting critical public facilities and schools. Critical facilities are considered to be health care, especially hospitals, and fire and police facilities. Facilities that are properly located and constructed, relative to natural hazards, will have less earthquake-induced damage or be subject to fewer other hazards, such as landslides and floods. These structures will be available for the use during, or following an emergency, and loss of life within such structures will be reduced and, perhaps, avoided entirely.

State and local governments risk their citizens' lives and businesses by allowing development in hazardous locations. Although there are requirements for use of codes and for earthquake resistant design in portions of Missouri, land-use policies related to natural hazards should be developed for all new critical structures and schools.

Existing structures may have no resistance to some hazards and inspections have not been programmed for existing critical facilities to assess earthquake vulnerability. Communities will benefit from the increased safety of critical facilities and schools.

## **Implementation**

Because new facilities can be constructed in safer locations, local government stakeholders should choose to locate new structures wisely. Legislation may be needed to specify that all hazards be considered when sites for critical facilities and schools are chosen. The State should cooperate with and provide technical support and other assistance to municipal and county governments as they develop policies and ordinances based on existing hazard maps. Additional hazard mapping funds are needed to adequately implement the strategy of protecting critical facilities and schools. State legislation could include incentives for local governments to develop zoning and other land-use planning procedures for reducing vulnerability of critical care facilities and schools to natural hazards.



Since existing facilities will not be impacted by the proper consideration of sites for new structures, local governments may wish to seek the advice of emergency management officials in assessing the vulnerability of existing critical facilities and schools. Many practical and low cost options can markedly decrease the harm caused by earthquakes and other hazards. Rehabilitation costs for existing structures are often greater than for equivalent designs of new buildings for the same hazard. On the other hand, the extreme consequences of losing a hospital or fire station during an emergency can greatly exceed the cost of improving the structure to withstand earthquakes and other hazards. Further, once damaged, critical facilities offer none of their intended response aid. Future generalized studies may be undertaken to evaluate important structures in high hazard areas.

**Responsible Agencies:**

Municipal (including service districts) and county government  
State Emergency Management Agency, Department of Public Safety (SEMA-DPS)  
Missouri Division of Geology and Land Survey, Department of Natural Resources  
(DGLS-DNR)

*Last Changed April 28, 1997*

## **STRATEGY:**

Support educational, regulatory, legislative and market-based efforts to promote insurer ability to respond to seismic catastrophes.

## **ACTION:**

Support educational efforts to aid the public in understanding their role in mitigating damage, the nature of catastrophe insurance, the role of deductibles, and threats to solvency. Support educational, regulatory and legislative efforts aiding the availability and affordability of insurance.

## **RESULT:**

There will be a financially sound catastrophic insurance business, wide public acceptance of need to carry earthquake insurance with substantial deductibles, and public support of commercial and residential earthquake-resistant building design. Adequate measures will be in place to assure that construction can withstand expected stresses in reasonably safe ways.

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## **Background**

A.M. Best, the independent insurance rating service, has in recent years lowered the financial ratings of numerous major insurers, declaring a need for them to reduce exposure to natural disasters.

There is a lack of public understanding of the role of adequate premiums, carefully crafted coverages, and sufficient adequate deductibles in the providing of catastrophe insurance. Even regulators may wish to participate in further education on these issues. Commercial and residential owners may wish to participate in lowering their risk by undertaking efforts to mitigate possible damage.

There is general acceptance of the need to improve building codes and other mitigation efforts. Insurers will support these state legislative efforts.

It is possible that Federal legislative proposals may emerge to promote solvency in the event of a catastrophe. These ideas and proposals should be considered in the light of state experience and needs, and should be supported if they further the goal of a solvent industry.

## **Implementation**

A working group should be established to determine Missouri's needs for revision of the catastrophic insurance system. The members of the group should include the insurance industry, state regulators, professional engineers, commercial and residential property owners, and perhaps a representative from the Insurance Institute for Property Loss Reduction. This group would bring together all stakeholders for the discussion of owners' risk-reduction responsibilities, insurer solvency, and availability of catastrophic insurance.

Consider Federal legislative remedies as they develop. Support state legislative efforts related to mitigation. Seek regulatory support for properly rated catastrophic coverage with adequate deductibles.

*Last Changed April 28, 1997*

### Objective 3: Improve Emergency Response.

*Response efforts need to be well coordinated, fast and efficient to reduce injury, additional loss of life, and further property destruction.*

| Strategy  | Action  | Result  |
|---|---|---|
| 3.1 Review the earthquake response component of the statewide integrated emergency management system.                                 | Develop an integrated emergency management system at all levels of government and the private sector to protect life, health, property and the environment following an earthquake event.   | Improved emergency response through more effective utilization of resources and personnel.  |
| 3.2 Promote community emergency response teams (CERTs) statewide.   | Train volunteer community emergency response teams statewide.   | Reduction of life, property and environmental loss by providing more immediate response in a disaster.  |
| 3.3 Support the formation, training and funding of Urban Search and Rescue Teams within the State of Missouri.                        | Train and organize specialty teams designed for intense search and rescue to augment local fire departments during major emergencies.   | Reduction of loss of life by mobilizing and deploying Urban Search and Rescue task forces with a significant capability for disaster response.      |
| 3.4 Promote development of emergency response plans at the State and local levels utilizing the Incident Command System.              | Develop comprehensive emergency response plans at State and local levels and test plans through exercises with first responders.  | Reduction of life, property and environmental losses by providing training and education for all first responders in a natural disaster.            |
| 3.5 Promote the selection and training of qualified local emergency response directors and their personnel.                           | Establish minimum job qualifications for local emergency response directors and develop programs for these directors and their personnel.   | Emergency response managers and personnel are trained and prepared to respond to an earthquake or other natural disaster.                           |
| 3.6 Evaluate mass care exercise and training programs for local emergency management and volunteer agencies who respond to disasters. | Evaluate and promote coordination of current multi-agency training and exercise programs under conditions expected after earthquakes, specifically between local emergency management and voluntary agencies. Promote identification of agency mass care roles and responsibilities in the event of a major disaster. | Local emergency management and voluntary agencies will know their mass care roles and responsibilities in a disaster and will coordinate responses. |

|  |  |   |
|--|--|---|
| 3.7 Expand and promote training in disaster mortuary and identify potential temporary mortuary sites in major population centers.    | Continue recruitment and training of the Missouri Funeral Directors Disaster Response Team (MFDADRT) and for mortuary personnel to be trained as Disaster Mortuary Coordinators for Mortuary Services. Support pre-disaster identification of temporary mortuary sites which can be accessed immediately in major population centers and/or in each of MFDA districts. | Trained personnel will be available to establish the means and methods for the most reasonable and proper care and handling of the dead in multi-death, earthquake disaster situations, and in the event of mass casualties. Potential use areas such as mortuaries, cemeteries and National Guard Armories are pre- identified in major population centers to be used as temporary morgue sites. |
| 3.8 Enhance communication capability and coordination for emergency response between State and local governments and private groups. | Develop viable alternative means of communications between State and local government entities and volunteer organizations.  | Emergency responders will have viable alternative means of communication in order to coordinate response during an earthquake emergency.  |
| 3.9 Enhance ability of emergency response personnel, materials and equipment to reach affected areas.                                | Identify and upgrade key transportation routes (roads, air, rail and water) to areas with a high risk of damage in the event of a major earthquake.  | Reduction of life, property and environmental losses and enhancement of the recovery process.   |
| 3.10 Promote mutual aid agreements between political subdivisions at local and State levels  | Support and encourage the establishment of mutual aid agreements.  | Mutual aid agreements will be established at the local and State levels.  |
| 3.11 Promote development of effective, coordinated response plans for utilities.   | Assess and mitigate earthquake risks and damage to utilities.  | Utility lifelines will continue to function or can be rapidly repaired after an earthquake.   |
| 3.12 Develop the capability to respond to multiple hazardous materials incidents.  | Determine the potential for hazardous material incidents following an earthquake and develop the necessary emergency response capability.  | Improved response to and recovery from hazardous material release after earthquakes.  |

*Last Changed 04/29/97*

## **STRATEGY:**

Review the earthquake response component of the statewide-integrated emergency management system.

## **ACTION:**

Develop an integrated emergency management system at all levels of government and the private sector to protect life, health, property and the environment following an earthquake event.

## **RESULT:**

Improved emergency response through more effective utilization of resources and personnel.

---

## **Background**

The concept of an integrated emergency management system focuses on the development of individual emergency response plans by State and local government agencies and public and private organizations in which the interrelation, coordination and cooperation of the various entities are considered. Unlike other natural disasters, such as floods or tornadoes, a major earthquake will occur without warning and the damage to structures, bridges and utilities will be much more widespread and severe.

One tool which can be utilized to enhance the emergency management system is a comprehensive database of resources (both public and private) throughout the State that could be called upon in an emergency. The State Emergency Management Agency has developed such a database; however, many local government agencies do not currently have access, due to computer equipment limitations.

## **Implementation**

Promote the concept of an integrated emergency management system to local emergency response coordinators, government agencies and public and private entities through seminars. Place special emphasis on response planning for earthquake events, to ensure that responders and critical facilities are functional after such an event.

Support the establishment of a statewide computer network for emergency response and the acquisition of computer equipment by local emergency response coordinators to enable access to the network.

**Responsible Agencies:**

Local, municipal and county governments

State Emergency Management Agency, Department of Public Safety (SEMA-DPS)

Volunteer and professional organizations

Private industry

*Last Changed April 28, 1997*

## **STRATEGY:**

Promote community emergency response teams (CERTs) statewide.

## **ACTION:**

Train volunteer community emergency response teams statewide.

## **RESULT:**

Reduction of life, property and environmental loss by providing more immediate response in a disaster.

---

## **Background**

In the immediate aftermath (first 72 hours) of an earthquake, standard emergency services will not be available. Research has shown that most rescue and emergency services are provided by untrained volunteers spontaneously functioning in damaged neighborhoods. This initiative would provide very basic training for interested people in fire safety, light rescue, disaster medical operations, hazard inspection, and other services. Grouped together within each community, as a part of neighborhood groups, church groups or professional organizations, these volunteers would be in place to act independently and spontaneously in the event of a disaster. They would be known and trusted by the people they would be helping. These volunteers will respond in their neighborhoods first, then go to staging areas to assist their local government's disaster efforts.

## **Implementation**

Four steps are required:

- Instruct elected officials, policy makers, police, fire and emergency management personnel on the use of volunteers in disaster response;
- Identify citizen groups and volunteer organizations;
- Distribute information and hold workshops through local public safety organizations and community service groups; and
- Continue to provide technical assistance and recertification to CERTs wishing to provide community-based relief. The steps would be accomplished under the direction of local Emergency Program Managers, with assistance from fire and rescue agencies in training volunteer community emergency response teams and team leaders.



**Responsible Agencies:**

State Emergency Management Agency  
Local Emergency Program Managers  
Fire and medical agencies  
Community groups of all types

*Last Changed April 28, 1997*

## **STRATEGY:**

Support the formation, training and funding of Urban Search and Rescue Teams within the State of Missouri.

## **ACTION:**

Train and organize specialty teams designed for intense search and rescue to augment local fire departments during major emergencies.

## **RESULT:**

Reduction of loss of life by mobilizing and deploying Urban Search and Rescue task forces with a significant capability for disaster response.

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## **Background**

Urban Search and Rescue is a plan of action for responding to disasters and for addressing the consequences of incidents or emergency situations when specialized personnel are needed for search and rescue.

The plan is applicable to natural disasters such as earthquakes, tornadoes, floods, dam failures and/or terrorist activities. As part of its disaster planning, mitigation and response function, the State Emergency Management Agency has implemented a plan to develop an Urban Search and Rescue capability within the State of Missouri. This concept, entitled Missouri based-US&R (Missouri Urban Search and Rescue), calls for the development of a tiered response system to catastrophic events which require urban search and rescue.

## **Implementation**

The Boone County Fire Protection District has coordinated and implemented the development of an Urban Search and Rescue Task Force. This US&R Task Force operates under the State Emergency Management Agency (SEMA) in a similar capacity to those established in California and several other states. Through a memorandum of agreement with the State Emergency Management Agency, the Boone County Fire Protection District serves as a resource for personnel, management, training and a portion of the equipment cache.

The task force will be deployed throughout Missouri by the State Emergency Management Agency. Requests for out-of-state responses would be made by FEMA to the State Emergency Management Agency in Jefferson City. The director of SEMA would then obtain the governor's consent to deploy the task force, the cost of which would be covered by FEMA.

Among the capabilities of each US&R Task Force are:

- Physical search and rescue operations in damaged/collapsed structures;
- Emergency medical care to disaster response personnel;
- Emergency medical care to the injured;
- Reconnaissance to assess damages and needs and to provide feedback to local, state and Federal officials;
- Assessment/shut off of utilities to houses and buildings;
- Hazardous materials surveys/evaluations;
- Structural/hazard evaluations of government/municipal buildings needed for immediate occupancy to support disaster relief operations; and
- Stabilizing damaged structures, including shoring and cribbing of damaged buildings.

The ultimate goal for the State of Missouri would be to have three (3) such teams, the first within the central part of the state, the second within the eastern part and the third in the western area. All teams would support and back-up each other if necessary.

**Responsible Agencies:**

- Federal Emergency Management Agency
- State Emergency Management Agency
- Department of Public Safety
- Fire and Medical Agencies

*Last Changed April 28, 1997*

## **STRATEGY:**

Promote development of emergency response plans at the State and local levels utilizing the Incident Command System.

## **ACTION:**

Develop comprehensive emergency response plans at State and local levels and test plans through exercises with first responders.

## **RESULT:**

Reduction of life, property and environmental losses by providing training and education for all first responders in a natural disaster.

---

## **Background**

With the exception of some large city fire and law enforcement departments, few officers or medical personnel will ever respond to a sufficient number of disasters to gain the experience needed for handling large scale emergencies. Most emergency service personnel are duly trained in basic rescue, aerial operations, and emergency medical care where up to ten patients may be involved. This is especially true of volunteer first responders.

## **Implementation**

Often the need for a plan is perceived only after a major problem or event occurs. One of the goals is to make all emergency service personnel aware of the need for comprehensive planning and proper training before a disaster occurs. The ability to plan, organize, command, and coordinate activities during a major disaster must be developed before the problem occurs.

All agencies should develop a disaster plan and be thoroughly knowledgeable about the plan. First responders must have fundamental knowledge of disasters and the ability to think and act quickly and decisively. Field exercises should be held to test the plan in order to disclose any and all weaknesses, so that changes can be made. All agencies must be thoroughly familiar with the Incident Command System.

## **Responsible Agencies:**

State Emergency Management Agency  
Department of Public Safety  
Local Emergency Program Managers  
Fire, Law Enforcement and Medical Agencies

## **STRATEGY:**

Promote the selection and training of qualified local emergency response directors and their personnel.

## **ACTION:**

Establish minimum job qualifications for local emergency response directors and develop programs for these directors and their personnel.

## **RESULT:**

Emergency response managers and personnel are trained and prepared to respond to an earthquake or other natural disaster.

---

## **Background**

The ability of local emergency response agencies to be effective, following a disaster, is directly related to the qualifications of those responsible for coordinating response efforts as well as training the emergency response personnel. In the State of Missouri there is currently no standardized job description for the position of local emergency response coordinator, nor minimum training requirements for emergency response agency personnel. In some instances, the emergency response coordinator serves voluntarily, with no compensation, or is a part-time employee with other full-time responsibilities. Other coordinators are full-time employees who devote their worktime to disaster mitigation, response and recovery planning and training of local emergency response personnel.

Training of emergency response personnel, including disaster simulation exercises, will enhance the capabilities of these personnel and allow for testing and improving the local emergency response plan. Not all local jurisdictions in Missouri participate in SEMA sponsored training exercises annually. This training ranges from a "table top" exercise to a full simulation of a disaster event.

## **Implementation**

Develop a standardized job description and support funding for a full-time qualified local Emergency Response Coordinator as defined by Chapter 44.090 of the Revised Missouri Statutes.

Promote training exercises for all local emergency response agency personnel.

**Responsible Agencies:**

State Emergency Management Agency  
State and Local Government  
Local fire, police, EMS and Public Works Agencies  
Private and Public Groups

*Last Changed April 28, 1997*

## **STRATEGY:**

Evaluate mass care exercise and training programs for local emergency management and volunteer agencies who respond to disasters.

## **ACTION:**

Evaluate and promote coordination of current multi-agency training and exercise programs under conditions expected after earthquakes, specifically between local emergency management and volunteer agencies. Promote identification of agency mass care roles and responsibilities in the event of a major disaster.

## **RESULT:**

Local emergency management and volunteer agencies will know their mass care roles and responsibilities in a disaster and will coordinate responses.

---

## **Background**

At the local level, when a disaster occurs, emergency management and various voluntary agencies like the American Red Cross and the Salvation Army are sometimes unclear about their joint mass care roles and responsibilities, especially regarding congregate shelters. In addition there seems to be a lack of knowledge regarding resources. There are not enough shelters or shelter staff currently available. A report by the California Seismic Safety Commission states that this was a major concern during California's recent earthquakes. Also, there was not a clear understanding regarding responsibility for shelter site selection or for staffing and operation of shelters.

In Missouri, this would not be a concern at the State level, but it could be of concern at the local level, especially in the smaller communities.

## **Implementation**

SEMA, in conjunction with local emergency management and voluntary agencies at the State and local levels, evaluates multi-agency exercise and training programs in the area of mass care to ensure that agencies know their roles and responsibilities during an earthquake or major disaster relief operations.

## **Responsible Agencies:**

State Emergency Management Agency  
Missouri Department of Social Services  
Local Emergency Managers  
American Red Cross  
Salvation Army

## **STRATEGY :**

Expand and promote training in disaster mortuary and identify potential temporary mortuary sites in major population centers.

## **ACTION:**

Continue recruitment and training of the Missouri Funeral Directors Disaster Response Team (MFDADRT) and mortuary personnel to be trained as Disaster Mortuary Coordinators for Mortuary Services. Support pre-disaster identification of temporary mortuary sites which can be accessed immediately in major population centers and/or in each of MFDA districts.

## **RESULT:**

Trained personnel will be available to establish the means and methods for the most reasonable and proper care and handling of the dead in multi-death, earthquake disaster situations, and in the event of mass casualties. Potential use areas such as mortuaries, cemeteries and National Guard Armories are pre- identified in major population centers to be used as temporary morgue sites.

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## **Background**

Appendix 2 to Annex T of the State of Missouri Emergency Operations Plan outlines the Special Mortuary Service SOP, New Madrid Earthquake, and Appendix 3 relates to Temporary Morgue Sites SOP. The Missouri Funeral Directors Association (MFDA) has an Emergency Preparedness Committee which meets quarterly. Training is conducted three times a year for members and non-members of the association. Members of the Missouri Funeral Directors Association also receive training through the State Emergency Management Agency and through the Federal Emergency Management Agency. They participate in exercises and drills.

MFDA indicated that currently the pre-identified mortuary sites are those generic sites mentioned above. The State may wish to consider pre-identification of the temporary sites in each of the MFDA districts as well as the major population centers.

## **Implementation**

Encourage continued training of State and local mortuary qualified disaster coordinators, trained disaster responders and other funeral service personnel through the Missouri Funeral Directors Association, SEMA, and FEMA. Pre-identify temporary sites in major population centers and in each of the MFDA districts.



**Responsible Agencies:**

State Emergency Management Agency  
Missouri Funeral Directors Association  
Missouri Department of Health  
State Highway Patrol  
Missouri National Guard  
Local Coroners/Medical Examiners

*Last Changed April 28, 1997*

## **STRATEGY:**

Enhance communication capability and coordination for emergency response between State and local governments and private groups.

## **ACTION:**

Develop viable alternative means of communications between State and local governmental entities and volunteer organizations.

## **RESULT:**

Emergency responders will have viable alternative means of communication in order to coordinate response during an earthquake emergency.

---

## **Background**

A key issue in implementing a coordinated emergency response effort is determining the magnitude and severity of the damage, as well as the type and scope of aid required. Past experience during emergency response coordination at state and local emergency operations centers has proven that cellular and commercial phone systems are effective communication tools. However, following a major earthquake, there is great potential that these means of communications may be interrupted. It is therefore imperative that alternative means of communications are available.

Currently the State has four alternative avenues of communication within damaged areas. These are the Missouri State Highway Patrol, the Missouri Water Patrol, ham operators and the Farm Bureau Satellite Network. In addition the Department of Safety, Division of Fire Safety has state-wide mutual aid frequencies available for fire departments. These frequencies are strictly for mutual aid responses, however.

The Missouri Highway Patrol has about 1,000 vehicles with radio communication and 14 aircraft. Within two hours of a major earthquake in the Bootheel area, over 200 patrol persons can be in the affected area, assuming major transportation routes are open. The ability of the Patrol to utilize its radio communications may, however, be affected by damaged relay towers.

The State Emergency Management Agency has a database of volunteer ham operators who can communicate with the State Emergency Operations Center. These volunteers can be a valuable asset; however, these individuals may have other immediate personal concerns (injured family, friends and property), so that utilization of this source of communication may not be available immediately following an earthquake.

In 1995, the State of Missouri entered into a cooperative agreement with the Farm Bureau Association to utilize its existing satellite communication network in the event of a State emergency. Every county in the area of potential damage from an earthquake is linked by this network. The ability to utilize this system will, in part, be dependent on whether the building housing the equipment survives the earthquake, the location of this equipment relative to the local emergency operations center, as well as the training of local emergency personnel in using the equipment.

In addition, the State Emergency Management Agency has explored the possibility of installing its own satellite communications network. The cost of installing such a network is estimated to be about \$200,000. Local government and emergency response agencies operate on their own radio frequencies. The ability of these various agencies to communicate is of great importance following a disaster.

## **Implementation**

Local emergency response agencies should identify all radio frequencies used by local government agencies, fire departments, EMS providers, volunteer agencies and other entities which could play a role in emergency response. This information should be incorporated in the State and local emergency response plans and the ability of the local emergency response agency to communicate with these other entities evaluated.

Emergency training exercises should be conducted to test the communications capabilities of local agencies.

A vulnerability study of the Farm Bureau Satellite Network should be conducted to determine if this means of communication would, in reality, be available in the aftermath of an earthquake.

Further consideration should be given to installing a Statewide Satellite Communications Network with the equipment housed in earthquake resistant structures where necessary.

Local emergency response managers should be trained in the use of the Farm Bureau Satellite equipment.

## **Responsible Agencies:**

- State Emergency Management Agency
- Farm Bureau Association
- Local Emergency Management Officials
- Local Political Subdivisions
- Local fire, police, EMS, and Public Works Agencies
- Private and Public Groups

*Last Changed April 28, 1997*

## **STRATEGY:**

Enhance ability of emergency response personnel, materials and equipment to reach affected areas.

## **ACTION:**

Identify and upgrade key transportation routes (roads, air, rail and water) to areas with a high risk of damage in the event of a major earthquake.

## **RESULT:**

Reduction of life, property and environmental losses and enhancement of the recovery process.

---

## **Background**

In the event of an earthquake or other natural disaster, access to the affected areas will be by highway, rail, air and water. Failure of roadways and bridges, railroad lines and bridges, airport runways and air traffic control systems, and waterway ports could severely hamper both the response and recovery process.

The Missouri Department of Highways and Transportation has compiled a "Risk Report of Structures" in which some 633 bridges have been identified for retrofitting. A retrofitting schedule has been developed based on whether the structure is along a main transportation route or a service road within an area. To date, 16 bridges have been retrofitted. The estimated cost of retrofitting the remaining bridges is about \$70 million. Two bridges of major concern are the Poplar Street Bridge in the City of St. Louis and the Caruthersville Bridge. Both bridges serve as a critical link to the areas they serve.

Several major railroad lines traverse through Missouri. Although rail lines within the areas of major damage would in all likelihood be severely damaged and inoperable, the rail system could be used to transport large quantities of emergency goods to staging areas. In addition, goods being carried on trains that have been derailed or stopped due to damaged tracks could be utilized. However, Federal Law prohibits seizure of railroad goods and services by State government, even in the event of a declared state emergency. Only the President of the United States or the Department of Defense has the right of seizure. Historically, however, the rail industry has voluntarily offered its services in the event of a natural disaster.

The Missouri and Mississippi Rivers are other sources of transportation for the State. Barges are used to transport goods and materials. The leading ports are St. Louis, Cape Girardeau, Caruthersville, New Madrid and Hannibal. If any of these ports are deemed operable following an earthquake, they would be useful in transporting emergency goods into affected areas.

There are 354 airports and 80 heliports in the State of Missouri. Fifteen airports are in the St. Louis area. Air transportation would be a quick and efficient way to import emergency personnel and some materials into a disaster region, provided that the airports and control towers survive. The State Emergency Management Agency (SEMA) has recommended that a study be done on airports and control towers to determine seismic vulnerability. From this information retrofits could be made to improve reliability after an earthquake event.

## **Implementation**

### *Highways:*

Identify key emergency routes into areas of potential significant damage in the event of an earthquake and review current bridge retrofitting schedule.

Continue and increase funding, if possible, for the retrofitting of key roadways and bridges.

Review and test the current post-earthquake damage assessment plan for highways and bridges.

### *Railroads:*

Identify rail lines which could be utilized to transport goods and personnel.

Conduct a vulnerability study of these rail lines and develop a staging plan.

Initiate discussions with railroad owners regarding utilization of both rail lines and goods after an earthquake. Formal agreements should be entered into if feasible.

### *Waterways:*

Identify key ports and determine if retrofitting can be done to improve survival.

Coordinate a plan with the Corp of Engineers, Port Authority, Missouri State Water Patrol, and the Coast Guard to determine port availability and accessibility following an earthquake.

Discuss with barge transportation companies the use of their services to transport emergency goods.

### *Airports:*

Conduct a study of the seismic vulnerability of airports and heliports in Missouri.

Identify the airports that would be most useful and implement retrofit improvements.

**Responsible Agencies:**

State Emergency Management Agency

Missouri Department of Transportation

Department of Economic Development, Div. of Transportation, Office of Railroad Safety

U. S. Army Corps of Engineers

Missouri State Water Patrol

Port Authority

Coast Guard

Federal Aviation Administration (FAA)

*Last Changed April 28, 1997*

**STRATEGY:**

Promote mutual aid agreements between political subdivisions at local and State levels.

**ACTION**

Support and encourage the establishment of mutual aid agreements.

**RESULT:**

Mutual aid agreements will be established at the local and State levels.

---

**Background**

Chapter 44.090 of the Revised Missouri Statutes allows local political subdivisions to enter into mutual aid agreements for emergency aid with other public and private agencies within and outside the State, provided such agreement is approved by the governor. Such mutual aid agreements allow for the sharing of resources and personnel in the event of an emergency.

Missouri is currently only one of three states which has a statewide Fire and Rescue Mutual Aid Agreement in place. This agreement allows fire and rescue units to respond to emergency events outside their jurisdictional areas, at the request of the local jurisdiction.

The State of Missouri is also currently exploring the feasibility of entering into mutual aid agreements with adjacent states and the Missouri National Guard is actively pursuing the development of such agreements with adjacent states.

In addition, St. Louis County has passed Ordinance No. 15,175 which allows for mutual aid agreements with political subdivisions in both Missouri and Illinois. As of January, 1995 only 13 of the 90 plus municipalities in St. Louis County have entered into such an agreement with the St. Louis County government.

**Implementation**

Promote mutual aid agreements between local political subdivisions by conducting informational seminars for elected officials and government agencies.

Actively pursue mutual aid agreements with adjacent States.

**Responsible Agencies:**

State Emergency Management Agency  
Local Political Subdivisions

**STRATEGY:**

Promote development of effective, coordinated response plans for utilities.

**ACTION:**

Assess and mitigate earthquake risks and damage to utilities.

**RESULT:**

Utility lifelines will continue to function or can be rapidly repaired after an earthquake.

---

**Background**

Critical elements of the infrastructure of many utilities are vulnerable to damage during earthquakes. There is potential for damage to electrical substations, transformers and transmission lines; the rupture or collapse of water, gas and sanitary sewer pipelines; damage to water and wastewater treatment facilities; as well as telephone switchgear and transmission lines. Cellular communication towers could collapse or become misaligned and thus inoperable. Disruption of water and wastewater service could pose a health risk, as could the loss of electrical or gas service should the earthquake occur during either the winter or summer months. Loss of telecommunications could hamper the response process and the rupture of gas lines and mains could result in fires.

Electric and gas service to eastern Missouri is primarily provided by Union Electric, Laclede Gas and the Rural Electric Cooperatives. Water and sewer service is generally provided by local private or government-owned utilities. Southwestern Bell is currently the primary telecommunications carrier in this area; however, several cellular telephone service providers have also established their presence.

Development of an emergency response plan by utilities under the jurisdiction of the Public Service Commission is currently voluntary and cannot be mandated due to the Hancock Amendment. Emergency response plans for government-owned utilities, such as municipally-owned natural gas systems, are part of the overall local government Emergency Response Plans.

Within the St. Louis area, there exists a voluntary Disaster Response Council which is composed of representatives of the local utilities. The purpose of this Council is to promote a coordinated effort in the response and recovery following an earthquake or other natural disaster.

Mutual aid agreements have been established by several utility providers with providers outside the area of potential earthquake damage.



## **Implementation**

Utilities should be encouraged to perform vulnerability studies of their facilities.

The development of an emergency response plan by each utility under the jurisdiction of the Public Service Commission should be promoted. These response plans should be coordinated with the local and state emergency response plan, tested and updated annually,.

Mutual aid agreements and voluntary coordination of emergency response efforts should be promoted.

### **Responsible Agencies:**

State Emergency Management Agency

Public Service Commission

Department of Natural Resources, Division of Environmental Quality

Department of Natural Resources, Division of Energy

Local government agencies and utilities

*Last Changed April 28, 1997*

## **STRATEGY:**

Develop the capability to respond to multiple hazardous materials incidents.

## **ACTION:**

Determine the potential for hazardous material incidents following an earthquake and develop the necessary emergency response capability.

## **RESULT:**

Improved response to and recovery from hazardous material release after earthquakes.

---

## **Background**

The Title III: Superfund Amendments and Reauthorization Act (SARA) program could be utilized to aid in the identification of facilities storing hazardous materials. Under the program, facilities report annually the hazardous materials stored for the past year (Tier II Reports). These reports are filed with the Local Emergency Planning Committee (LEPC), the Division of Fire Safety (Missouri Emergency Response Commission), and the local fire departments. The LEPCs are formed by the county but sometimes several counties will form one LEPC. The LEPCs would be a good source for identifying facilities; however not all LEPCs have a computer database of the Tier II Reports. The State Emergency Management Agency (SEMA) is working towards putting computers with emergency response software in every LEPC office and forming a state-wide network. This is a very important step in the identification process.

Since the potential number of hazardous material releases after an earthquake is expected to be large. The Missouri Department of Natural Resources (DNR) will be overwhelmed with reported incidents. DNR has six regional offices along with the central office which would work together in disaster recovery. Three full-time hazardous materials people are needed at each regional office.

Fire departments would also be very involved in dealing with hazardous material releases. The LEPCs would work together with the local fire departments to conduct training and emergency exercises to deal with hazardous material releases. Funding is needed for the Division of Fire Safety to provide on-going training on hazardous materials and equipment.

## **Implementation**

Use an electronic data base to identify and track potential sources of hazardous material release following earthquakes, and provide the resources and training needed to respond to likely hazardous material incidents.

Local Emergency Planning Committees will need computers and software for collecting and managing data on the locations, nature and uses of hazardous materials. Local fire departments will need equipment and training to respond appropriately to multiple hazardous material incidents. The Missouri Department of Natural Resources needs additional hazardous material staff to coordinate data management and training.

**Responsible Agencies:**

Missouri Emergency Response Commission  
State Emergency Management Agency  
Missouri Department of Natural Resources  
Division of Fire Safety  
Local Fire Departments  
Local Emergency Planning Committees

*Last Changed April 28, 1997*

## Objective 4. Improve Recovery.

*A well-designed recovery process helps people resume their normal lives, by reducing the emotional and economic impact of the disaster over the long term.*

| Strategy  | Action   | Result   |
|---|--|--|
| 4.1 Identify and designate earthquake resistant short- and long-term shelters.  | Identify suitable, earthquake resistant short- and long-term shelters and coordinate agreements for their use.   | Earthquake resistant short- and long-term sheltering facilities will be available following a major disaster.  |
| 4.2 Develop contingency plans for the location, design and construction of long-term temporary housing.                                       | Plan for the construction of long-term temporary housing.  | Long-term temporary housing will be available for victims displaced by a major earthquake.   |
| 4.3 Promote funding and training of post-earthquake building inspection volunteers.   | Continue to train volunteers throughout the State of Missouri to make rapid visual examinations of buildings.  | By using a system already in place for training, certifying and mobilizing volunteers, structures that are safe for occupancy can be rapidly identified after an earthquake or other disaster. This will permit housing and jobs to be quickly restored. |
| 4.4 Enhance the ability of individuals and small businesses to recover from an earthquake disaster.   | Enable entrepreneurs and small businesses to recover from an earthquake and to access funding at the Federal and State levels in a timely manner so that economic recovery progresses. | The adverse economic impact of an earthquake will be reduced in the affected area.   |
| 4.5 Enhance emergency management and coordination between the Federal, State, and local agencies.   | Develop a coordinated emergency management system to provide rapid and systematic response following a seismic event.  | Emergency response capability will be enhanced by coordinated responses to local requests for assistance in the immediate post-earthquake phase of events.   |
| 4.6 Encourage further development of a central State group to accept relief donations and coordinate distribution.                            | Develop a State Donations Management Plan through the Governor's Disaster Recovery Program.  | A State Donations Management Plan will ensure coordination and allow efficient and timely distribution of gifts-in-kind.   |
| 4.7 Support identification of facilities and methods for disposal of uncontaminated debris and hazardous materials from collapsed structures. | Prepare a plan for disposal of hazardous materials, contaminated and uncontaminated debris.  | Coordination will result in improved and efficient, coordinated disposal of hazardous materials and uncontaminated debris.   |

|  |  |  |
|--|--|--|
| 4.8 Enhance ability to provide crisis counseling to individuals in affected areas. | Develop a network of trained counselors who will respond to and provide counseling to residents in affected areas. | Residents, particularly children, will be able to understand and cope with the emotional trauma following an earthquake. |
|--|--|--|

*Last Changed 02/04/97*

**STRATEGY:**

Identify and designate earthquake-resistant short- and long-term shelters.

**ACTION:**

Identify suitable, earthquake resistant short- and long-term shelters and coordinate agreements for their use.

**RESULT:**

Earthquake resistant short- and long-term sheltering facilities will be available following a major disaster.

---

**Background**

Disaster plans frequently identify buildings and facilities such as schools, churches, community centers, etc., as care and shelter centers. These are suitable for the short-term use (one to two weeks), but are almost never available on a long-term basis (up to two months). In most cases, the facilities are not earthquake resistant. Even with the best of planning and preparation and, with the combined resources of government, the Red Cross, and other voluntary agencies, it will be difficult to identify enough of those facilities.

**Implementation**

Mass care sheltering needs following an earthquake must be addressed by disaster preparedness and planning. Both short- and long-term shelters must be identified and designated prior to an earthquake. Structures should be assessed to determine their vulnerability to a seismic event. Agreements should be entered into for the use of these facilities.

**Responsible Agencies:**

State Emergency Management Agency  
Missouri Housing and Development Commission  
Missouri Department of Social Services  
Missouri Department of Economic Development  
American Red Cross  
Salvation Army

*Last Changed April 28, 1997*

## **STRATEGY:**

Develop contingency plans for the location, design and construction of long-term temporary housing.

## **ACTION:**

Plan for the construction of long-term temporary housing.

## **RESULT:**

Long-term temporary housing will be available for victims displaced by a major earthquake.

---

## **Background**

In the event of a major earthquake (magnitude 7.6), the American Red Cross, Disaster Services, estimates that over 725,000 Missourians will require temporary housing, with over 465,000 of these individuals located in the metropolitan St. Louis area.

An estimated 154,700 of the victims will initially seek housing in public shelters (schools, churches, tents, etc.) run by volunteer organizations. However, these facilities generally operate for a period of only 60 to 90 days. After this time, individuals who are unable to return to their homes due to significant damage may require long-term temporary housing. It is critical to the well-being of these victims that this housing be quickly identified so that they can begin rebuilding their lives.

The local emergency management agency should develop a contingency plan for providing housing prior to the disaster, so that adequate housing can be constructed rapidly when needed.

## **Implementation**

The first step in developing a long-term temporary housing plan is to establish a committee consisting of local emergency management personnel and planning and zoning representatives, as well as individuals from the engineering and construction communities.

This committee should be responsible for evaluating existing rentals in the area to identify existing facilities which may survive and be habitable following a major earthquake. Identifying property which could be utilized to construct long-term temporary housing, taking into consideration road access and the availability of utilities evaluating a variety of prefabricated housing products on the market to identify those which would be best suited for use in the affected areas and developing a plan for the closure and dismantling of long-term housing areas to ensure that this "temporary" housing does not become "permanent".

**Responsible Agencies:**

Local Emergency Management Agency  
Local Governments  
Volunteer Organizations  
Planning and Zoning Personnel  
Engineering and Construction Community  
Housing and Urban Development

*Last Changed April 28, 1997*



## **STRATEGY:**

Promote funding and training of post-earthquake building inspection volunteers.

## **ACTION:**

Continue to train volunteers throughout the State of Missouri to make rapid visual examinations of buildings.

## **RESULT:**

By using a system already in place for training, certifying and mobilizing volunteers, structures that are safe for occupancy can be rapidly identified after an earthquake or other disaster. This will permit housing and jobs to be quickly restored.

---

## **Background**

In 1991, the State Emergency Management Agency (SEMA) and the leadership of engineering and architectural professional societies began to develop a program for post-earthquake volunteer inspectors. A coalition, called SAVE was formed to handle this task by the the Missouri Society of Professional Engineers (MSPE), the Missouri Chapters of the American Society of Civil Engineers (ASCE) and American Institute of Architects (MO/AIA), and the Consulting Engineers of Missouri (CECMo) . The SAVE Coalition was organized to train and mobilize volunteer inspectors in the event of an earthquake or other disaster, if necessary.

If a disaster requiring SAVE volunteers occurs, local authorities will contact SEMA and request support. An estimate is made of the number of required volunteers and SEMA contacts the SAVE Coalition State and Regional Coordinators. In the event of a large disaster, it is anticipated that volunteers will be mobilized from outside the affected area because the local volunteers may be required to care for their families or their own structures or businesses.

## **Implementation**

The ability of the Coalition to assist local building inspectors in evaluating structures is directly related to the availability of qualified, trained volunteers. Continued, and increased, funding is needed to promote the program and train volunteers, including refresher courses.

Volunteers from outside the areas of greatest potential damage are especially important, since individuals within these areas may have other immediate personal concerns. Continued planning is also needed for mobilizing and housing volunteers from outside the affected area.

**Responsible Agencies:**

Local governments  
State Emergency Management Agency  
Professional Organizations

*Last Changed April 28, 1997*

## **STRATEGY:**

Enhance the ability of individuals and small businesses to recover from an earthquake disaster.

## **ACTION:**

Enable entrepreneurs and small businesses to recover from an earthquake and to access funding at the Federal and State levels in a timely manner so that economic recovery progresses.

## **RESULT:**

The adverse economic impact of an earthquake will be reduced in the affected area.

---

## **Background**

Depending on the severity of the event, delayed economic recovery of the affected area could be as disastrous as the property losses. In addition, with most of the jobs in the private sector being created by small businesses (some reports indicate up to 80 percent), access to Federal and State programs becomes vitally important to these small business owners. The consensus is that the larger, national and international companies doing business in the affected area of an event will have staff personnel who are familiar with ways to tap into emergency funding programs.

Many small businesses, particularly in rural parts of the state, provide essential support services that will be needed as part of public efforts to assist areas recovering from an earthquake. A small business could be as ordinary as a gasoline station or a community grocery store.

## **Implementation**

Develop informational packets and practical guidelines on the small business application procedures, and business planning for disaster response and recovery; distribute this information through public awareness and education programs and extension services. Recommend to the Federal government that a streamlined approach be used for loan applications during the post-disaster period.

## **Responsible Agencies:**

Federal Emergency Management agency  
State Emergency Management Agency, Department of Public Safety (SEMA-DPS)  
Small Business Administration  
Job Service

## **STRATEGY:**

Enhance emergency management and coordination between the Federal, State, and local agencies.

## **ACTION:**

Develop a coordinated emergency management system to provide rapid and systematic response following a seismic event.

## **RESULT:**

Emergency response capability will be enhanced by coordinated responses to local requests for assistance in the immediate post-earthquake phase of events.

---

## **Background**

Response to disaster has always been focused on local emergency management levels. When local resources are committed to response, the State has the responsibility to assist the locals to overcome shortfalls. When State resources are fully committed or appear to be completely exhausted, requests are made to the Federal government alleviate the State's shortfall, as well as that of the local government units. One method to increase the likelihood of rapid response and recovery is to anticipate suspected shortfalls and plan to obtain these resources from other States or the Federal government. \f2Communication

is essential in coordinating rapid response between the various levels of government.

## **Implementation**

The State of Missouri needs to work closely with the Federal Emergency Management Agency at regional and national levels to coordinate policies and plans that will allow rapid deployment of Federal and other States' resources. Planning efforts at the FEMA regional level should be encouraged with predesignated deployments of essential personnel to work with the State in the earliest stages of the disaster. Additional planning efforts on the essential emergency support functions (ESFs) of the Federal Response Plan (FRP) between Federal and State representatives should be continued under the FEMA Region VII Regional Interagency Steering Committee program. This will allow the FEMA representatives to meet with their state counterparts and familiarize the Federal representatives with the operational procedures within the State. In turn, this will provide for FEMA sponsored resources to supplement (not supplant) existing State resources and allocations.

Other important facets of emergency management are interstate compacts that are currently being passed between various states under the aegis of the Emergency Management Assistance Compact (EMAC). EMAC will allow recipient states to interchange and accept resources from states outside the affected areas of the earthquake. Resources will be requested from donor states as required by the states in need. The States not affected by the disaster should be familiar with the concept of operations used by the requesting states in order to streamline the request process to avoid confusion and duplication of requests. These discussions can be carried out through the Regional Interagency Steering Committee (RISC) program as well as through coordination with CUSEC and its constituent members.

Furthermore, local government units need to have input into this process through local emergency operations and recovery plans. The local government units are the ones facing the brunt of emergency operations. They need to examine their shortfalls for response (and recovery), prioritize requests for assistance, and avoid making duplicate requests. Input from the local government units may be gathered in several ways: through an Area Coordinator system, from the annual SEMA/MEPA Conference and through the State's emergency exercise program.

### **Responsible Agencies:**

- State Emergency Management Agency - Planning Section
- Federal Emergency Management Agency - Region VII
- Other Federal Agencies
- Central United States Earthquake Consortium
- Local governments (particularly Emergency Management)
- State agencies (with emergency response and recovery functions)

*Last Changed April 28, 1997*

**STRATEGY:**

Encourage further development of a central State group to accept relief donations and coordinate distribution.

**ACTION:**

Develop a State Donations Management Plan through the Governor's Disaster Recovery Program.

**RESULT:**

A State Donations Management Plan will ensure coordination and allow efficient and timely distribution of gifts-in-kind.

---

**Background**

Historically, donations of gifts-in-kind saturate communities affected by a major disaster or those which receive significant media attention. Normally, the mechanism to coordinate acceptance of goods and their distribution is not in place. If agencies have plans for acceptance of goods, they may be overwhelmed before they are able to implement their plans. Plans are often not coordinated between communities and with State government. Some states have plans which address how state government will handle gifts-in-kind donations and how to control their distribution.

**Implementation**

SEMA continues to work with members of the Governor's Disaster Recovery Partnership to develop a comprehensive State Donations Management Plan for gifts-in-kind which will be formulated using FEMA guidelines. Various State and voluntary agencies accept the plan and agree to participate in the plan during an earthquake or other major disaster operation. These agencies would add annexes to the State Donations Management Plan indicating acceptable gifts-in-kind.

**Responsible Agencies:**

State Emergency Management Agency  
Federal Emergency Management Agency  
State Office of Administration, Division of Surplus Properties  
Missouri Department of Transportation (MoDOT)  
Volunteer Agencies, e.g., American Red Cross, Salvation Army

*Last Changed April 28, 1997*

**STRATEGY:**

Support identification of facilities and methods for disposal of uncontaminated debris and hazardous materials from collapsed structures.

**ACTION:**

Prepare a plan for disposal of hazardous materials, contaminated and uncontaminated debris.

**RESULT:**

Coordination will result in improved and efficient, coordinated disposal of hazardous materials and uncontaminated debris.

---

**Background**

Following an earthquake, large quantities of building debris, both contaminated and uncontaminated, will need to be removed from disaster sites for disposal. The volume of material will possibly be more than local landfills or approved hazardous disposal facilities can handle in an efficient, timely manner.

**Implementation**

Develop debris disposal plans that address the potential for large volumes of expected uncontaminated and non-hazardous debris and the special handling and disposal for contaminated and hazardous debris.

**Responsible Agencies:**

Local Emergency Planning Committees  
Missouri Emergency Response Commission  
State Emergency Management Agency  
Missouri Department of Natural Resources  
Division of Fire Safety  
Local Fire Departments

*Last Changed April 28, 1997*

## **STRATEGY:**

Enhance ability to provide crisis counseling to individuals in affected areas.

## **ACTION:**

Develop a network of trained counselors who will respond to and provide counseling to residents in affected areas.

## **RESULT:**

Residents, particularly children, will be able to understand and cope with the emotional trauma following an earthquake.

---

## **Background**

There are licensed counselors, psychologists and psychiatrists throughout the State. These professionals could be reached through their respective professional associations. It would be appropriate to allow these individuals to coordinate the effort of mobilizing and staffing emergency counseling centers. SEMA, through a liason, would have oversight to ensure that the plan for crisis counseling would adequately cover the entire state.

By working with professional organizations of licensed counselors, psychologists and psychiatrists, a plan can be developed and a volunteer network of personnel can be established to provide counseling to earthquake victims. The plan should include the identification of facilities to be used as counseling centers, and development of training programs for teachers and clergy as well as professional personnel. The Department of Mental Health should work with the federal government to determine the extent of federal participation in the plan.

## **Implementation**

A committee comprised of representatives from the responsible agencies should be formed to begin coordination of resources and development of a plan of action. The plan of action will deal with items detailed above.

## **Responsible Agencies:**

State Emergency Management Agency  
Department of Economic Development, State Committee for Professional Counselors  
Department of Economic Development, State Committee of Psychologists  
Department of Mental Health, Division of Comprehensive Psychiatric Services  
Department of Elementary and Secondary Education



## Objective 5. Assess Earthquake Hazard.

*Readiness for an earthquake requires basic knowledge about expected earthquake locations and the effects of local site conditions on shaking as well as rapid notification of their occurrence.*

| Strategy   | Action   | Result  |
|--|--|---|
| 5.1 Map and identify natural geologic hazards.   | Complete earthquake hazard maps of counties subject to damage by earthquake shaking.   | Hazard mapping will provide a single, uniform source to identify Missouri's geologic hazards.   |
| 5.2 Support a statewide, real-time earthquake monitoring system.                         | Fund and install seismometers, telemetry and processing equipment capable of alerting State officials, emergency managers, and the public within minutes of an earthquake. Monitor all active earthquake regions in the State. | The rapid announcement of major earthquake parameters will improve emergency response by outlining severity of the disaster. A focus for earthquake education in elementary and secondary schools is created in addition to furthering fundamental studies of earthquakes and earthquake ground motions in the State. |
| 5.3 Develop a geoscience response team to identify and evaluate post-earthquake effects. | Investigate landform changes caused by an earthquake.  | Areas affected by earthquake induced landform changes will be identified to assist recovery efforts and to evaluate post-earthquake land use risks.   |
| 5.4 Develop generalized soil profile parameters for ground shaking analysis.             | Recommend generalized soil profiles for ground motion hazards analysis.  | Analytical modeling of ground shaking through generalized soil profiles permits improved assessment of Missouri's property hazards when combined with local hazard maps.  |

*Last Changed 02/12/97*

## **STRATEGY:**

Map and identify natural geologic hazards.

## **ACTION:**

Complete earthquake hazard maps of counties subject to damage by earthquake shaking.

## **RESULT:**

Hazard mapping will provide a single, uniform source to identify Missouri's geologic hazards.

---

## **Background**

Two earthquake hazard maps with geologic emphasis have been produced. The most recent is that of the greater St. Louis area at a scale of 1:100,000. Work has begun on the third map that includes portions of the Cape Girardeau-Bootheel area. Larger scale maps at 1:24,000 scale are contemplated but require increased funding because of the detail required. Classification of earthen materials to identify shaking susceptibility could utilize a standard Central United States Earthquake Consortium (CUSEC) descriptive format.

Legislation established by the Missouri General Assembly and individual legislators' interest have given much encouragement to earthquake investigations. Mapping efforts have been supported in part by FEMA/SEMA and the National Earthquake Hazard Reduction Program (NEHRP) in coordination with CUSEC.

Private and government infrastructure losses occur due to natural geologic hazards. Geologic hazards can be identified and mapped for the benefit of communities. Local governments, when informed of risk-based losses, are in a position to guide land use in a manner compatible with the geologic hazards. Flooding and landslides are frequent reminders of losses from imprudent land use. Earthquakes present the greatest loss potential to life, injury and economic welfare in the state. Potential destruction can be reduced by prudent land use. Costs associated with identifying and making known geologic-hazard areas are repaid many times over in reduced financial and personal injury losses to a community. Hazard mapping helps identify the best sites for new structures and aids in evaluating of existing buildings.

With the natural hazard information provided, property developers and land owners are able to assess the best use of the property. Many potential hazards, if recognized, require minimum precautions to avoid later property damage and life risk. Without such information, serious property damage and other risk conditions will develop that otherwise could have been avoided.

Hazard maps would enable local and state governments to better guide land use and would contribute to long term cost reductions to the government, as well as to the private sector. Incentives could be offered to local governments for encouraging hazard recognition.

## **Implementation**

Completed maps have been widely requested and distributed by the thousands.

Completion dates for maps at 1:100,000 scale to include all of eastern and southeastern Missouri extend beyond the year 2000. Delays are greater for the more useful 1:24,000 scale maps even though these detailed maps are needed for accurate application of building codes. Additional funding is needed for realistic completion dates.

Legislation or reward-based State policy should encourage local governments to adopt geologic-hazard ordinances. Local governments need technical assistance, ordinances and enforcement model programs for their use.

Legislation is necessary to require geologic hazard mapping for those types of facilities that affect the general public and to enable local governments and others to require such maps when deemed appropriate locally.

## **Responsible Agencies:**

Division of Geology and Land Survey, Department of Natural Resources (DGLS-DNR)

County Governments

State Emergency Management Agency, Department of Public Safety (SEMA-DPS)

*Last Changed April 28, 1997*

## **STRATEGY:**

Support a statewide, real-time earthquake monitoring system.

## **ACTION:**

Fund and install seismometers, telemetry and processing equipment capable of alerting State officials, emergency managers, and the public within minutes of an earthquake. Monitor all active earthquake regions in the State.

## **RESULT:**

The rapid announcement of major earthquake parameters will improve emergency response by outlining severity of the disaster. A focus for earthquake education in elementary and secondary schools is created in addition to furthering fundamental studies of the earthquakes and earthquake ground motions in the State.

---

## **Background**

Instrumental recording of earthquakes provides the basic data required to understand the earthquake process and the ground motions, in addition to defining the size and location of each earthquake. Monitoring since 1975 has focused on earthquakes near New Madrid, Missouri, as well as southern Illinois. Adjacent active areas in Missouri have not been as well monitored. Support for earthquake monitoring has decreased due to changing Federal interest.

An equipment upgrade, which is underway, focuses on monitoring earthquakes near New Madrid as well as in a very broad region to the east and south of Missouri. Current tasking, however, does not permit monitoring earthquakes in northwest and southern Missouri.

Recent technological advances in California show that real time seismic data can be used to provide rapid earthquake locations, useful for an initial assessment of a major disaster as well as for ensuring safety of rescue crews by warning of imminent shaking from large aftershocks. Missouri does not have these capabilities because of the sparse geographical coverage by seismic networks and difficulties in transmitting real-time data to an analysis center.

## **Implementation**

The existing network of seismograph stations must be augmented to become a State-wide system with specific responsibilities of notifying SEMA of the earthquake location and magnitude within minutes. This information must be tied to geographic and geotechnical data bases to present an initial estimate of the severity of the disaster. The additional stations should be placed at universities and schools to make use of internet communication capabilities. Real-time seismic traces, earthquake locations and other information should be provided to all schools and museums throughout the State by Internet as part of earthquake education efforts.

## **Responsible Agencies:**

State Emergency Management Agency  
Saint Louis University

*Last Changed April 28, 1997*

## **STRATEGY:**

Develop a Geoscience response team to identify and evaluate post-earthquake effects.

## **ACTION:**

Investigate landform changes caused by an earthquake.

## **RESULT:**

Areas affected by earthquake induced landform changes will be identified to assist recovery efforts and to evaluate post-earthquake land use risks.

---

## **Background**

Earthquakes sometimes affect the earth's surface by uplifting, downwarping, or tilting large areas; during some large earthquakes surface fault rupture occurs. Liquefaction (when surface materials behave as a liquid as a result of ground shaking) occurs during moderate to large earthquakes, and may affect large areas. Sand boils and sand fissures sometimes occur during moderate to large earthquakes. Landslides and/or lateral spreading may occur on slopes of as little as 1 to 2 degrees.

Surface water courses and groundwater levels may be changed. Water quality may also be affected: sometimes it degrades and sometimes it improves. Areas that are well drained before an earthquake may become flooded and areas that were wetlands or shallow water bodies may dry out after an earthquake. The courses of some natural drainage, especially those near local base level, may change. The apparent depth of the water table may change because of the raising or lowering of the land surface. Lateral groundwater flow may be affected by fault gouge, sand fissures or areas of liquefaction.

One impact is that man-made, gravity-flow systems, e.g., canals, ditches and sewers, may be disrupted or the designed drainage profile changed. This may result in those systems not working properly. In some areas flow may be reduced to zero or backflow may result and deposition may occur. In other areas, flow may be increased, which may cause scour, erosion, or bank failure.

Structures, including buildings, levees, roadways, transmission lines and towers, can be directly affected by fault rupture, sand boils and fissures, liquefaction, landslides and lateral spreading, and other earthquake-induced landform changes.

There is high risk for changes to natural and man-made drainage systems due to wide spread uplift, downward, tilting and local settling in the lowlands of southeast Missouri which includes the most likely epicentral areas for large earthquakes on the New Madrid fault system. This area is extremely flat-lying, sometimes having less than one foot of relief over several miles. During the 1811-1812 series of earthquakes, uplift, downwarping, and tilting of up to 10 feet or more occurred over hundreds of square miles.

Southeast Missouri, including all or parts of Dunklin, Pemiscot, New Madrid, Mississippi, Stoddard, Scott, Butler, Bollinger, and Cape Girardeau counties, is highly developed agriculturally and includes some of the most productive agricultural land in Missouri and the nation.

The agricultural development has only been possible within the last century because of the installation of a series of man-made drainage systems. Prior to this, the area was often saturated to the point of having standing water at the surface. These man-made drainage systems, including some in northeast Arkansas, have been developed and administered by several private drainage districts. All have been "cooperatively engineered" --- that is, the channels and ditches have been designed and installed to most effectively drain excess water from the land and deliver it ultimately to the Mississippi and St. Francis Rivers. The channels cross drainage district borders as well as state boundaries.

On a smaller scale, there are hundreds of municipal water distribution and wastewater collection systems in southeast Missouri that may also be adversely affected by earthquake-induced uplift, downwarp, or tilting.

## **Implementation**

The geoscience response team would document all observable landform change and damage, such as landslides, liquefaction features, sand blows, fissures, water course changes and flooding, and other earthquake-induced effects. The report generated by the team will present essential information for emergency response and post-earthquake recovery work, and for short- and long-term preparedness and mitigation planning.

No training or team mobilization trial runs for a geoscience response team have been implemented in Missouri although the DGLS has developed an operational plan, including designated geologists, needed equipment, mobilization and other immediate-response activities. Lack of funding and scheduling has prevented training implementation. Sufficient numbers of people must be trained because not all team members will be available and because the smallest team size is three persons for safety reasons. While one team may suffice for a small event, several teams may be required for even a moderate earthquake. Funding and experienced USGS direct staff support are essential requirements for training. The teams should consist of geoscience, geotechnical, lifeline and highway professionals.

## **Responsible Agencies:**

Division of Geology and Land Survey, Department of Natural Resources (DGLS-DNR)

U. S. Geological Survey (USGS)

Other State and Federal agencies

*Last Changed April 28, 1997*

## **STRATEGY:**

Develop generalized soil profile parameters for ground shaking analysis.

## **ACTION:**

Recommend generalized soil profiles for ground motion hazards analysis.

## **RESULT:**

Analytical modeling of ground shaking through generalized soil profiles permits improved assessment of Missouri's property hazards when combined with local hazard maps.

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## **Background**

Recently produced earthquake hazard maps with geologic emphasis, including one for the greater St. Louis area at a scale of 1:100,000, focus on broad scale geologic properties that indicate hazard, e.g., likelihood for liquefaction and or landslide. Hazard assessment requires knowledge of how local geological properties affect expected ground motions. This can be done by defining generic soil property profiles in the state and using them in computer models to predict local effects. Classification of earthen materials to identify shaking susceptibility could utilize a standard Central United States Earthquake Consortium (CUSEC) descriptive format.

The professional community has powerful procedures for evaluating potential ground motion at a site. Such investigations are expensive for siting, planning and preliminary design, because extensive site information resulting from borings, soil testing and geophysical investigation is required. On the other hand, development of generalized soil profiles would quantitatively assist in hazard assessment when combined with the geologic hazard mapping and expected ground motion overlays.

## **Implementation**

Create generalized soil models for specific counties or hazard maps. Generalized soil profiles would allow design software to initially assess sites before the expense of the necessary field testing and structural design phase. The resulting initial guidance would clarify the economic considerations for planning, site selection and development. Generalized soil profiles could be augmented with site specific data to refine ground shaking parameters for evaluation of existing or future structures. Knowledge of local site conditions permits realistic assessment of damage potential of existing structures.



Several resources would be brought together to develop generalized soil models. The DGLS has the professional capability to define the generalized soil profiles. State agencies, consulting firms and professional societies possess soil and rock information and Federal agencies have data bases of soil and rock properties, including shear wave velocities. A programmatic approach to soil profiles should be developed for their use with either 1:100,000 or 1:24,000 scale hazard mapping.

**Responsible Agencies:**

State Emergency Management Agency, Department of Public Safety (SEMA-DPS)  
Division of Geology and Land Survey, Department of Natural Resources (DGLS-DNR)

*Last Changed April 28, 1997*

## Missouri Statutes Related to Earthquakes (as of 1995)

The purpose of this tabulation is to highlight progress that Missouri has made in addressing the earthquake problem through legislation.

|  |  |
|--|--|
| 44.023   | Earthquake and natural disaster volunteer program established, agency's duties--expenses--immunity from liability, exception   |
| 44.225,44.227,44.229,44.231,44.233,44.235,44.237 | Seismic Safety Commission  |
| 70.837   | Emergencies--public safety agencies may provide aid to public safety agencies in state and bordering states                    |
| 160.451  | Earthquake emergency system to be established for certain school districts   |
| 160.453  | Requirements for emergency system - public inspection of system authorized   |
| 160.455  | Distribution to each student certain materials on earthquake safety - duties of school district                                |
| 160.457  | School districts may elect to adopt certain provisions of earthquake emergency program   |
| 256.155  | Interstate earthquake emergency compact  |
| 256.170,256.173, 256.175                         | Geologic Hazard Assessment   |
| 319.200, 319.203, 319.205, 319.207               | Notice to cities and counties subject to earthquake to adopt seismic construction and renovation ordinances, when -- standards |
| 379.975, 379.978                                 | Earthquake insurance   |

# Commission Members

## *Commissioners*

- Susan W. Clowe (1995- ) American Red Cross
- Marie Collins (1995- ) Metropolitan St. Louis Sewer District
- William L. Durbin (1995- ) Woodward Clyde Consultants
- Phillip L. Gould (1995- ) Washington University
- Gregory L. Hempen (1995- ) Corps of Engineers
- Robert B. Herrmann (1995- ) Saint Louis University
- Senator Jerry T. Howard (1997- ) Missouri General Assembly
- Ernest H. "Bud" Hunt (1995- ) Daily Dunklin Democrat
- Jennifer Marino (1995- ) City Utilities of Springfield
- Robert E. Palmer (1995- ) Melville Fire Protection District
- Marilyn A. Roberts (1995- ) State Farm Insurance
- Thomas R. Schwetye (1995- ) Schweyte Architects
- Phyllis J. Steckel (1995- ) EQE-Theiss, Inc.
- Carol J. Tharp (1995- ) Platte County Emergency Management Agency
- John C. Theiss (1995- ) Theiss-EQE
- Representative Larry Thomason (1995- ) Missouri General Assembly
- Kennard O. Whitfield (1997- ) City of Rock Hill
- *Former Commissioners*
- Charlise Floyd (1995) American Red Cross
- Patricia A. Killoren (1995) City of Crestwood
- Marge Schramm (1996) City of Kirkwood
- Senator Irene Treppler (1995-1996) Missouri General Assembly
- 

## *Commission Officers*

- Chairperson
  - R. B. Herrmann (1997)
  - G. L. Hempen (1995- 1996)
- Vice Chairperson
  - P. L. Gould (1997)
  - W. L. Durbin (Co-Chair 1996)
  - R. B. Herrmann (Co-Chair 1996)
  - E. E. Hunt (1995)
- Secretary
  - W. L. Durbin (1997)
  - S. W. Clowe (1996)
  - C. J. Tharp (1995)
- Treasurer
  - T. R. Schwetye (1997)

### ***Ex-officio Members***

- David Elam (1996- ) Jefferson County Planning Department
- Ann Elledge (1996- ) Center for Earthquake Studies
- Christine M. Vetter (1996)
- James H. Williams (1996- ) Director, Division of Geology and Land Survey

### ***Agency Contacts***

- Jerry B. Uhlmann, Director, State Emergency Management Agency
- Paul D. Schleer, Deputy Director, State Emergency Management Agency
- Edward s. Gray, State Emergency Management Agency, MSSC Staff
- Joe Rachel, Federal Emergency Management Agency, Region VII, MSSC Liason

*Last Changed 02/07/97*

# Glossary

## ***Acronyms***

*AIA*-American Institute of Architects

*ASCE*-American Society of Civil Engineers

*BOMA*-Building Owners and Managers Association

*Bootheel*-Southeastern corner of the State of Missouri; so named because of its shape.

*CECMo*-Consulting Engineers Council of Missouri

*CERT*-Community Emergency Response Teams

*CES*-Center for Earthquake Studies (Southeast Missouri State University - Cape Girardeau)

*CSR*-Code of State Regulations (Missouri)

*CUSEC*-Central United States Earthquake Consortium

*DGLS*-Division of Geology and Land Survey

*DNR*-Department of Natural Resources

*DPS*-Department of Public Safety

*EERI*-Earthquake Engineering Research Institute

*EMAC*-Emergency Management Assistance Compact

*ESFs*-Emergency Support Functions (see FRP)

*FEMA*-Federal Emergency Management Agency

*FRP*-Federal Response Plan

*ISTEA* - *Intermodal Surface Transportation Efficiency Act*

*LEPC*-*Local Emergency Planning Commissions*

*LEPCs*-*Local Emergency Planning Commissions*

*MEPA-Missouri Emergency Preparedness Association*

*MFDA-Missouri Funeral Directors Association*

*MFADART-Missouri Funeral Directors Association Disaster Response Team*

*MIRMA-Missouri Intergovernmental Risk Management Association*

*MML-Missouri Municipal League*

*MoDOT-Missouri Department of Transportation*

*MSPE-Missouri Society of Professional Engineers*

*MSSC-Missouri Seismic Safety Commission*

*Mercalli-Qualitative effects of earthquake damage*

*NEHRP-National Earthquake Hazard Reduction Program*

*PSC- Public Service Commission*

*RISC-Regional Interagency Steering Committee (see FEMA)*

*SAVE-Structural Assessment and Visual Evaluation*

*SEMA-State Emergency Management Agency*

*UBC-Uniform Building Code*

*US&R-Urban Search and Rescue*

*USGS-U. S. Geological Survey*

*USGS-U. S. Geological Survey*

*USSC-Utah Seismic Safety Commission*

## ***Definitions***

*Hazard - an act or phenomenon that has the potential to produce harm or other undesirable consequences to people or objects.*

*Hazardous structure - a structure whose condition creates an imminent danger of physical injury, harm or damage to people or objects within or nearby.*

*Non-structural hazard - a condition or phenomenon in a structure that is unrelated to the structural system but which has the potential to produce harm or other negative consequences to people or objects within or nearby. Examples include non-load-bearing architectural elements and mechanical and electrical components of the building system.*

*Risk - the probability that the potential harm or negative consequences of a hazard will be realized. This is the combination of the underlying hazard and vulnerability.*

*Structural hazard - a structural condition in a structure that has the potential to produce harm or other negative effects on people or objects within or nearby. This is due to the failure of the structure to withstand the vertical gravity loads or lateral seismic forces acting on the structure.*

*Vulnerability - susceptibility to injury, harm, damage or economic loss.*

*Last Changed 02/04/97*

# **Sources of Information**

## **Information on earthquake mitigation/preparedness/response**

State Emergency Management Agency  
Attn: Earthquake Program Manager  
P. O. Box 116  
Jefferson City, Missouri 65102-0116  
573/526-9500

## **Information and lectures on earthquake hazard**

Center for Earthquake Studies  
Southeast Missouri State University  
1 University Plaza  
Cape Girardeau, Missouri 63701  
573/651-2019

## **Information on recent earthquake locations**

Earthquake Center  
Saint Louis University  
St. Louis, Missouri 63108  
314/977-2236

## **Maps and hazard information**

Department of Natural Resources  
Division of Geology and Land Survey  
P. O. Box 250  
Rolla, Missouri 65401-0250  
573/368-2100

*Last Changed 02/13/97*